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ON THE TREATMENT AND UTILIZATION OF ANTHROPOLOGICAL DATA.

By ARTHUR THOMSON, M.A., M.B.

IV.—HEIGHT.

THE question of height is one which requires careful consideration. Apart from the mere enumeration of measurements, and the averages deduced therefrom, we have to ascertain as far as possible the factors which determine those variations in stature. The height of the body depends not only on the length of the trunk and head combined, but also on the length of the lower limbs. We may have individuals possessed of trunks of the same proportions, but differing much in height, in such, the difference is due to the variation in the leg length. Common experience shows that it is a matter of difficulty to estimate correctly the individual height of a group of people seated round a table; it is only when they rise from their chairs that we gain a correct idea of their relative proportions.

In order to understand our increase in stature from childhood to the adult condition, the reader must be familiar with the mode in which the long bones grow. Each long bone is provided with a shaft and two extremities, and these several parts are each developed from independent ossific centres; thus the shaft, or diaphysis, grows from a single ossifying column, while the extremities, or epiphyses, are developed from one or several ossific nuclei. In consequence, the growth of the bone in length takes place in relation to each extremity, and so long as this growth is going on, we assume that the individual has not reached the stage of maturity.

A study of the statistics relating to growth has shown that there are periods in our life when development is taking place more quickly than at other times. Thus in the early years of infancy, increase in bulk takes place with great rapidity, succeeded by a period when growth is more slow and uniform. About the age of puberty, however, a fresh stimulus seems to stir the tissues, and hence we have at this time an increase in height often characterised by marked rapidity. As these changes must of necessity be associated with a great increase in the number, and it may be, in the size of the cells which constitute the tissues of our body, it is obvious that at these times of special activity the drain on the system must be great, and can only be met by the provision of suitable food, and surroundings congenial to health.

Here, then, we have very sound reasons for taking all possible precautions to provide a diet adapted to meet the requirements of the organism, for failing such it can be readily understood how the natural growth might be stunted for want of proper nutrition. But it is not merely a question of food, the surroundings are, in a way, almost as important. Statistics prove that those whose occupation keeps them out of doors are as a rule taller than those whose labours confine them to a closer atmosphere, and it is just at the age that the boys and girls of our manufacturing centres are turned into the factories that they are most likely to benefit by improved hygienic conditions. It is a matter for congratulation that recent legislation has to some extent improved the condition of the "half-timers."

But whilst errors in growth may be partly accounted for by modified nutrition and varying climatic and hygienic influences, the facts above stated are not sufficient to explain the circumstance that we meet with races living side by side displaying very different proportions. Just as in the case of the Italian greyhound we have a breed distinct from its near ally the English greyhound, so we have in mankind those races which are characterised by their small height as contrasted with the larger proportions of other members of the same stock, thus proving that heredity is a factor of no small importance. Considering the vast admixture of blood in most of the populations that are scattered over the surface of the earth, it is almost impossible to get satisfactory data as to permanency of type, yet recent experience in this country and in France has proved that evidence of a confirmatory sort may frequently be obtained in support of the migration and location of certain stocks. In what we call the English and the Scotch we have a mixed race, and though an average derived from all the measurements taken may be of service for comparison with the population of other countries, it must be pointed out that the resulting figure does not correspond to the height of the greatest number of people. In every race there are a certain number of individuals below or above what we may term the most common height; the smaller individuals may outnumber, balance, or fall short of the taller individuals, so that their inclusion in the average may, and often does, detract from the value of the result. For this reason the height of a race is best expressed by means of

a binomial curve, as was first suggested by Quetelet and Galton. By the adoption of such a method we are at once able to recognize the standard of height attained by the greatest number of individuals, whilst the sides of the curve will illustrate the proportions of the various individuals who fall either short of, or exceed, the common standard. In this way we are more likely to obtain accurate information regarding what we may term the type height, and the range and numerical value of the variations. The mathematical method of Prof. Karl Pearson attains the same end, but in this simple case does not appear to possess any obvious advantage over the older method.

Unfortunately, the bulk of the observations placed at our disposal are in the form of averages, so that it is difficult in these cases to estimate the extreme of variation.

Amongst tall races are included those that measure 1 mètre 70 centimètres (5 feet 7 inches) and over. The races of medium height vary from 1 mètre 60 centimètres (5 feet 3 inches) to 1 mètre 70 centimètres (5 feet 7 inches), whilst the short races have a height of 1 mètre 60 centimètres (5 feet 3 inches) or under.

The tall include such races as the Patagonians, West African negroes, some Polynesians, some American Indians, Scandinavians, and Scotch and English. The short, among others, include the Malays, Lapps, Veddahs, Bushmen, Hottentots, Negritoes (or dwarf Asiatic negroes), the Negrillos—adopting the term suggested by Hamy—which include the Akkas, a dwarf form of African negro. It is these small or pigmy races to which, of late years, so much attention has been directed; their wide-spread distribution, as well as the fact that they are by many regarded as primitive types, lend an interest to their study quite distinct from their physical peculiarities. Additional importance has been imparted to the study of the pigmy races by Prof. Kollman's discovery, near Schaffhausen, of the remains of a race of pre-historic dwarfs, the bones of which were mingled with those of a much taller race with whom they must have lived, though, whether in a state of "peaceful harmony," as suggested by the distinguished professor, is another matter. The remains of four such neolithic pigmies were met with, and estimating their height from an examination of their leg bones, it was found that on an average, assuming their bodily proportions did not materially differ from those of living forms, their height did not exceed 1 mètre 42 centimètres (4 feet 8 inches), so that, as regards their stature, they correspond closely with the Negritoes inhabiting the Andaman Islands and the Bush race of South Africa.

Apart from the Lapps, whose height as a rule is about 1 mètre 53 centimètres (about 5 feet), we have other races of small people inhabiting different parts of Europe. According to Sergi, people of a height not exceeding 1 mètre 50 centimètres (4 feet 11 inches) are met with in Sicily and Sardinia, where, he states, they form quite fourteen per cent. of the population; and from observations made by the same anthropologist there appears little doubt that a correspondingly short race is met with in Central European Russia. This naturally gives rise to the question whether there may not be some association with the dwarf African peoples, as suggested by Sergi in his view of the diffusion of the Eur-African race along the Mediterranean shores.

Turning now to the consideration of the best known race of living pigmies, we find them located in the more or less inaccessible group of islands in the Bay of Bengal, called the Andamans. Though subjected to European influence since the year 1857, and rapidly undergoing physical and moral deterioration from their contact with civilization, yet a record has happily been kept of their physical proportions, as well as their social customs, arts, language, etc., by Mr. E. H. Man. Prof. Sir William H. Flower has described their skeletons, and, in discussing their affinities, has thrown out the suggestion that they are probably "the primitive type from which the African negroes on the one hand, and the Melanesians on the other, may have sprung." In appearance they resemble little negroes (hence the name Negritoes). Their average height for the men is about 1 mètre 42 centimètres (4 feet 8 inches), for the females about 1 mètre 37 centimètres (4 feet 6 inches). The hair is very fine, and curled in the form of short ringlets, so as to present a frizzy or woolly appearance. The colour of the skin is dark, whilst the features are a modification of the Negro type, displaying less projection of the jaws, and lips not so coarse and thick.

Closely allied to the Andamanese are the Aëtas, the dwarf races who inhabit the mountainous district in the interior of the Island of Luzon, whose height on an average is only 4 feet 8 or 9 inches.

Similarly populated are other islands of the Philippine group, and so also races of a corresponding type are met with in Formosa, the interior of Borneo, and in the Celebes, but curiously enough no trace of them has hitherto been found in Java. This is particularly interesting, as here Dr. Dubois made his most remarkable discovery of the Trinil skull, undoubtedly the earliest human remains yet found, all the facts pointing to the conclusion that it probably belongs to the younger Pliocene. Along with this skull a thigh bone was found, presumably a part of the same skeleton. Estimated from this, according to human proportions, the height of the individual to whom it belonged would be 1 mètre 65 centimètres to 1 mètre 70 centimètres (5 feet 5 inches to 5 feet 7 inches); considerably taller, it will be noted, than the stature of the Negritoes, and obviously upsetting the theory that the Negritoes are a survival of the primitive stock which peopled that part of the earth.

In Africa, the existence of pigmy races has long been hinted at. Aristotle, Heroditus, and Pliny all make reference to them, and in an interesting work entitled "Man transformed, or the Artificial Changling," published by John Bulwer, in 1653, a summary of the then state of knowledge is given, wherein reference is made to the occurrence of such races in Greenland, Lapland, Tartary, India, Africa, and Peru, the various authorities being quoted with much precision and show of critical acumen. To this subject the distinguished French anthropologist, Prof. Quatrefages, has recently directed attention in a work entitled "The Pigmies."* Therein the reader will find an interesting account of the distribution of these dwarf races and the conclusions derived therefrom.

The Bush race, which inhabits the southern portion of the African continent, has long been familiar to Europeans, averaging 1 mètre 40 centimètres (4 feet 7 inches in height); they agree closely with the Andamanese. In hair, however, they differ from the negro, for though extremely frizzy, it displays a tufted arrangement as if the scalp was covered with little woolly balls. In colour they are yellower than the negro, and display other physical peculiarities which serve to distinguish them from the other inhabitants of the continent. Though leading the life of degraded savages, they are not without their talents, for, as Mr. A. W. Buckland has pointed out,† their drawings and paintings will

* Translated by F. Starr. London: Macmillan & Co. 1895.

† "Anthropological Studies." London: Ward & Downey. 1891.

bear comparison with the Cavemen and Eskimo. The Bush race had probably at one time a much wider distribution throughout Africa and overflowed into Madagascar, where evidence of a dwarf population has been recorded by le Clerc, though whether or no they are the same stock as the other Negrillos found further north is still an open question.

Necessarily giving way before the more powerful Bantu races on the north, and harassed by the English and Dutch colonists from the south, they are fast going the way of all the weaker races in the struggle for existence. Their near neighbours, the Hottentots, though differing from the Bushmen in respect of height, are generally supposed to be a mixture of the Bush and Bantu races.

The recent exploration of Africa has done much to lift the veil of mystery surrounding the legendary dwarfs who dwell near the head waters of the Nile. Schweinfurth obtained one of these Akkas, as they are called, from the King of the Monbuttu, but lost him by death on his way to Berber. The Italian traveller, Miani, succeeded in bringing home to Italy two Akka boys, whom he obtained by barter. These little fellows were made much of, and finally became pages in the service of the Count Miniscalchi Erizzo. Similarly, Wissman, Stanley, and Emin Pasha, all refer to the same or allied races, and the latter explorer sent to the British Museum the skeletons of a male and female, which have been carefully described by Sir W. H. Flower. The result of the measurements of one of these skeletons was that the height of the female was determined at a little over 4 feet (1 mètre 21 centimètres). The other skeleton, the male, was not sufficiently complete from which to form an accurate estimate. On the whole, however, we may assume the average height of the males as 1 mètre 40 centimètres (4 feet 7 inches), that of the females as 1 mètre 30 centimètres (4 feet 3 inches). They are therefore a smaller race than the Andamanese. In respect of hair they are frizzy, and not tufted as the Bushman, and Emin describes them as covered all over the body by "a thick stiff hair, almost like felt." Their colour is lighter than most negroes, and their features display the negroid characters in marked degree—viz., pronounced prognathism, or projection of the jaws, together with full everted lips, in this respect contrasting with the Andamanese. In one point only do they differ in marked degree from the negro, that is in the form of the head, which is rounder and more spherical.

From what has been said regarding these dwarf races it will be apparent that though at present they survive only in the most inaccessible parts of the continents throughout which they are scattered, and are slowly succumbing to the influence of their more sturdy neighbours, none the less they are interesting as displaying a permanency of type, which is independent of climatic conditions, for we find the tall and short races dwelling side by side or in immediate proximity to each other, and it is for this reason that whilst an average may express the mean of the sum of the heights of the population of a country, it often conceals the fact that that population is made up of many individuals of tall stature intermingled with a certain proportion of people of smaller proportions. Apropos of this, Dr. Brinton remarks that "Since the intermingling of two races does *not produce a third race*, it is not likely that any of the existing races arose from a fusion of two others. The result of observation shows that after two or three generations the tendency in mixed breeds is to recur to one or other of the original stock, not to establish a different variety." It is for this reason then that we would lay special stress on a more detailed study of the heights of different populations, for just as we have seen that colour, hair, and bodily proportion are all of service in enabling us to trace the strain, so it would appear that height also is of service in assisting us to trace the influence of a parent stock. As yet we have not referred to the question of cranial form, the consideration of which must be discussed in future articles.

THE KARKINOKOSM, OR WORLD OF CRUSTACEA.—X.

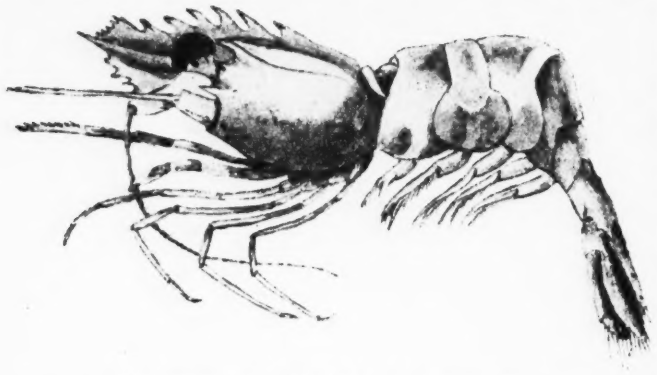
By the Rev. THOMAS R. R. STEBBING, M.A., F.R.S., F.L.S., F.Z.S., *Author of "A History of Crustacea," "The Naturalist of Cumbrae," "Report on the Amphipoda collected by H.M.S. 'Challenger,'" etc.*

WEAPONS AND WILES.

AMONG the pictures of the year is one entitled "Wonders of the Shore." A delightful young lady, who has apparently been skirt-dancing, barefoot and alone, on the cool wet sands, is struck with astonishment at the sight of a Common Shore Crab (*Carcinus maenas*). Had she ventured to touch it with her naked toes, it might have added a new and truly impromptu figure to her dance. It is valiant exceedingly—far more valiant than polite. But it is not so much a wonder of the sea-shore as one of its commonest objects. At the beginning of this century vast numbers of this species were sold in London to the poor, who in those simple days esteemed them a great delicacy. At present, in England, for gastronomic purposes, there can scarcely be said to be more than one crab. Other crabs may be eaten, one alone is the "Eatable Crab." Thousands of persons consume it, in a heartless sort of way, without caring to know that its proper name is *Cancer pagúrus*. Occasionally they discover, without being carcinologists, that when alive it can inflict a painful pinch with the nipper of its mighty claw. There is, indeed, an old opinion that in proportion to its size this familiar crustacean is the strongest of all animals. Such a superiority might be difficult to establish if any obstinate person asked for the guarantee of calculation and experiment, tabulating the energy of mice and midges, crabs and crocodiles, in the common terms of horse-power or foot-pounds. Herbst genially endeavours to make the thing probable, not by these tedious methods, but by adducing the testimony of two reputable eye-witnesses, Minasi and Randazzo. The former had the good luck to see one of these crabs fight a stubborn battle with a black snake, without ever letting itself be caught in the coils or engulphed in the maw of the reptile. On the contrary, it so pinched and tore it that the snake, all flecked with gore and grievously abashed, now alarmed for its own safety, made way for its adversary to retire. Whereupon the crab, though still in fighting attitude, as much as to say "Come on if you dare," moved sideways to the water's edge, not folding its warrior arms till it sank into the sea. Randazzo, on his own estate, saw a like combat between a crab and a viper. Here, too, the venomous animal got the worst of it, finding its fangs of no avail upon its antagonist's carapace. In this instance, however, the cunning crustacean from time to time strengthened itself by eating marjoram, which grew on the field of battle, and then with heightened courage returned to the encounter with its proud (but less wily) opponent. In days of old sweet marjoram was a recognised remedy for drooping spirits and various other ailments. A modern crab no doubt takes other tonics, though it is surprising that its indisputable bravery should need them.

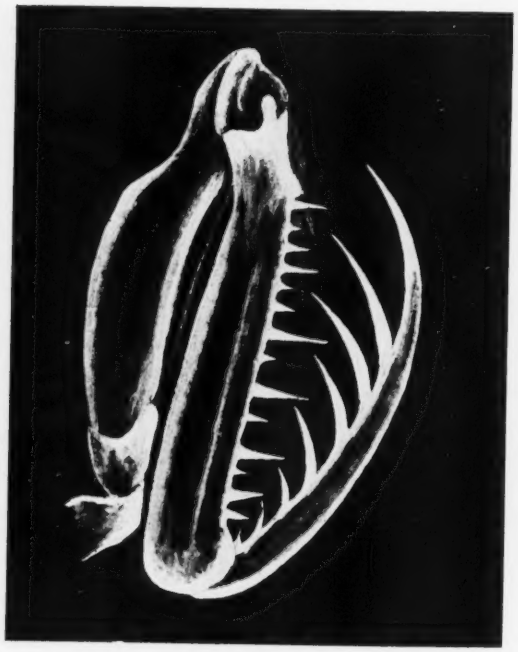
XUM

It is all very well for mankind to agree to put the sword into its scabbard and keep it there. In the case of several crustaceans the following of this pacific example would not be by any means easy. Crabs and lobsters, it is true, do sometimes cast off their formidable cutting and pinching chelæ of their own accord. But there is always



Spirontocaris spinus (Sowerby). From Spence Bate.

a faint suspicion that they do this after they have had their fill of fighting, and when the mauled and battered weapons have become no longer serviceable to their owners. They speedily proceed to grow new ones, at first small and weak, as if only for the look of the thing, but in



Raptorial Claw of *Squilla raphidea* Fabricius. M. A. S.

course of time their armature comes out as good as ever, or possibly a little improved.

When we turn to the prawns, we find many of them equipped in such a way as to put suppression of armaments out of the question. You cannot sheathe a sword that is an immovable projection from your own head. This part of a prawn's organization is called the rostrum. Its shape, its dimensions, the number and order of its teeth above and below, are seized upon by the naturalist for convenient specific characters. When they vary within the species, as they not unfrequently do, they become as specific characters very inconvenient. But all the prawn wants with them is that they should be characters inconvenient to his enemies. To fishes, such as are found sometimes with a small museum of fish-hooks inside them, the sword of a prawn may make no difference. Such a fish will swallow the prawn, sword or no sword. But the fact that we cannot defend ourselves against earthquakes and thunderbolts is not a reason for exposing ourselves defenceless to a multitude of smaller mischiefs. Probably the serrate rostrum of the prawn is not intended for attack, so much as to ward off objectionable advances, and, in the last resort, to induce a disgust for an other-wise much appreciated flavour by lacerating the gullet and stomach of small-sized aquatic epicures. The latter way of teaching them not to do it again must be expensive to both parties, and one may speculate whether it becomes efficacious by the extinction of the gourmands, or by some subtle spreading of experience throughout their tribe. In some prawns the rostrum is supplemented by another and a more dangerous-looking weapon. The plate attached to the second joint of the second antennæ, which is often broad, and has the function of a float or balancer, is in *Oplóphorus*, the Weapon-carrier, transformed into a sharp pike. Unlike the rostrum, which is almost always immovable, this bayonet-like organ can be turned about to give the enemy an oblique or sideways thrust, an uncomfortable dig in the ribs, well qualified to teach a small fish to control in future an unchastened appetite.

In the last chapter, the Squillidæ were referred to as a sort of pirates, lurking in their submarine tunnels—on the pounce. In this small, peculiar group, Nature shows no squeamishness. It is not for meek humility of self-defence, but evidently for rapine, that they are endowed with their raptorial claws. In the reckoning of appendages these correspond with the second maxillipeds, which are rather feeble mouth-organs in the crab, the lobster, and the shrimp. Far otherwise is it with their character in the Squillidæ, and in the great *Squilla raphidea* of the Pacific Ocean they attain a remarkable development. The two last joints, often spoken of as the hand and finger, may well arrest attention. The finger has its inner margin divided into eight sharp graduated sabre-like teeth, and in repose it shuts like the blade of a clasp-knife into a groove along the hand or handle. This groove itself is margined with several unequal spines at right angles to its outer edge, and three long ones making acute angles with its inner border. When the *Squilla* is pleased to close this piece of machinery with a sudden snap upon a passing object, only a very tough customer can hope to escape from that death-dealing labyrinth of teeth and spines.

However fierce and formidable a few of the crustacea may look, we need not attribute to any of them ambition, the desire of conquest, or the love of domineering for its own sake. All those virtues they leave to us, but for themselves they want food and offspring and personal safety. Unless these can be secured, it is of no use to say to them, "Down with your arms." They won't listen. Their otoliths, or earstones, will not vibrate in response to your appeal. But many of them are willing to obtain their ends by very quiet methods. Without venturing to affirm

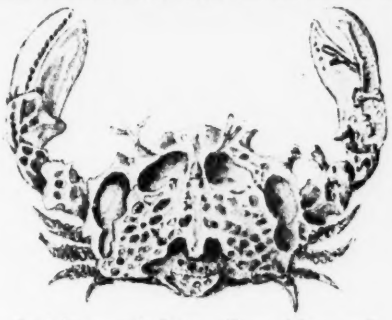
that in many positions they try to look as if they weren't there, or that they deliberately endeavour to wear an

Parthenope horrida (Linn.). From Guérin-Méneville.

unappetizing aspect, one may safely say that if they don't try they often succeed without trying. In the fauna of Great Britain and Ireland, we have some little crabs, which may be distinguished as Pennant's *Ebalia*, Bryer's *Ebalia*, Cranch's *Ebalia* and Norman's *Ebalia*, after the naturalists who either acted as their publishing agents, or who first brought their merits to light. These small crabs love the deep waters. They are not without some personal adornment, and there may be a season of their lives when they will run risks in order to display it, but in general they find their advantage in resembling little muddy rugged bits of stone. It is from stony ground that they are drawn to the unwelcome light of day by the merciless dredge or some exceptional storm. In cliffs and quarries, we often please ourselves by making out a human profile or perhaps the figure of a couching lion. Niobe and her children have been carved in the rock without the aid of a sculptor. There the accidental and the inorganic mimic the forms which we associate with living organisms. The Great Warty Crab (*Parthenope horrida*) makes an opposite appeal to our ingenuity. It sets its fellow-creatures the problem—though without the smallest desire that they should solve it—to find the living crab in what looks like a casual fragment of rock. From Guérin-Méneville's drawing, that might not seem to be a difficult puzzle. There are, however, certain points to be borne in mind. It was the artist's business to show as clearly as possible all the details of the organism. It is the crab's business to conceal them. It cares not a whit whether we can make out its specific characters, and would bear without a murmur the calamity of being referred to a wrong genus. It gathers up its arms and its legs into the smallest possible compass, inconsiderately making it quite difficult for any one to observe the shape of its external maxillipeds, or to see whether it has seven distinct joints in its tail as a *Parthenope* ought to have. The tail itself, usually so smooth a part in a crab, is here pitted and eroded like a weathered piece of sandstone. As for the tolerably symmetrical appearance, which the drawing displays, and which properly belongs to true crabs in general, no doubt a fish with an æsthetic eye might consider the circumstance suspicious. But this crab, though unversed in the biography of Sherlock Holmes, is not so weak as to expose such a clue. It tosses on a rag of seaweed here and there, in a negligent manner, so as to perfectly conceal the artfulness of its art. *Oreóphorus reticulatus* of Adams and White, as may be seen from the picture, is a crab which plays the same sort of game.

Many crabs, and especially those of the tribe Oxyrrhyncha, indulge in a highly elaborate costuming, about which much has been written of late. The improved and multiplied aquaria of recent times have given opportunities for accurate observation of this strange procedure. It had, indeed, been long ago recorded that several species, which in youth had a smooth and shining carapace and legs but slightly tomentose, assumed in age a very different appearance. They seemed to become, as it were, "Half-suffocated in the hoary fell, and many-winter'd fleece of throat and chin," being all overgrown with the submarine fauna and flora among which they lay. In their fakir-like existence, they incurred the epithets of slow and sluggish, inert and languid, inactive and apathetic. When Leach discovered his *Inachus dorhynchus* from the Salcombe Estuary, he reasonably considered that this very circumstance of its being generally overgrown with marine matter had concealed it from earlier notice. Adams and White say of *Camposcia retusa*, from the Philippine Islands, that "as it advances in life, the carapace and legs become covered with a thick, woolly, yellowish-brown tomentum, and, in

Lambrus carinatus Milne-Edwards. From Adams and White.



Oreóphorus reticulatus. From Adams and White.

advanced age, the entire animal is concealed by a covering of Sponges, Corallines, Algæ, Actiniæ, and Alcyonia, beneath which it is impossible to recognise the species." Since crustaceans in general are subject during the larger part of their lives to periodical casting of the skin, it is evident that advancing age has very little to do with the forests upon them. These do not grow out of the crabs like the cherry tree out of Baron Munchausen's stag. They are under the control of the crustacean itself, to wear or not to wear, and can be adopted without any tedious waiting for their growth. The *Lambri*, which are numerous throughout the China Sea, living on submerged beds of broken shells and muddy gravel, suit themselves to their situation, many species, according to Adams and White, appearing "at first sight to be made up of a conglomerated mass of small stones and sand."

Our regard for all these animals must be heightened, now that we know more about their action and inaction. Neither the one nor the other is governed by vanity or superstition, or sloth. They know their own business and do it. Like naturalists, they find the absolute necessity of a quiet, retired life for carrying out their purposes. To secure this, they exchange the pomps and vanities of existence for a modest garb of mud and stones, or, availing themselves of their peculiar tubules and their uncinate and serrate spines, they deliberately plant upon their bodies a grove or tangle of such animals and vegetables as are suited to grow there. After all this trouble, it would be ridiculous for them to go scuttling around, and so to let all sorts of intruders and busybodies know their whereabouts, which they have been at so much pains to conceal. When they are forcibly transferred from one set of surroundings to another, they have an instinct which teaches them to change their dress to suit their new environment. This instinct, or faculty higher than instinct, is commended to the reader as a matter suggestive of many pleasing and interesting experiments.

A CONTRAST IN NOSES.

By R. Lydekker.

Of all the features of the human countenance none seems more prone to exhibit marked variations in size and shape than the nose. A broad and flattened nose is, for instance, characteristic of negroes and Australian natives, whereas the classic or Grecian nose is found only among the highest types of the Caucasian races of Europe. But while the nasal organs of the lower races of mankind differ in general from those of the higher peoples of Western Europe, yet it is among the latter that perhaps the greatest amount of variation in this respect may be noticed. And although even among these mixed Western nations a considerable amount of such nasal variability is evidently hereditary and distinctive of particular families or races, yet there are many instances in which it appears largely individual, although it may, of course, be due to reversion. Be this as it may, it will suffice for our present purpose to note that among European races a distinctly "snub-nosed," or "tip-tilted," type is not uncommon on the one extreme, while at the other we have what is commonly called the "long-nosed" type; the latter being broadly distinguished from the arched Roman, or aquiline, nose.

Now, it is a remarkable fact in natural history that whereas the great majority of the monkeys and apes of the Old World have noses of an ordinary pattern, that is to say, not very far removed from the type characterizing the inferior representatives of the human race, three of them have developed peculiarities in this respect which entitle them to be regarded as among the most extraordinary of all four-footed beasts. And not the least remarkable circumstance in connection with these nasal eccentricities is that the two extremes are found in members of a single group inhabiting widely distant and completely isolated areas.

Before referring to the species displaying these remarkable peculiarities, it will be well to briefly refer to their nearest relatives. These are most familiarly known by the sacred Hanuman monkey, or Langur, of India, which is one of a large group of species inhabiting most of the Oriental countries; one kind, the Himalayan Langur, being found at a considerable elevation in the outer hills of the mighty range from which it takes its name. And in winter, or early spring, these large grey monkeys may frequently be seen disporting themselves among pines heavily laden with snow. As distinctive features of the Langurs, reference may be made to their slim build, long hind legs and tail, and the absence of pouches in the cheeks for the storage of food. Their hair is long and coarse, and may be of any colour from slaty grey to bright foxy red or black. All have, for monkeys, fairly well-formed noses, of ordinary dimensions. Unlike the majority of the members of their order, they feed on leaves in preference to fruits; and, as showing how similarity of habit gives rise to similarity of structure (or, if the reader so please, *vice versâ*), it is interesting to note that the Langurs have complex stomachs, strikingly similar to those of sheep and ruminants in general; most other monkeys having simple stomachs of the normal type.

As already mentioned, the three species of monkeys which have gone in for eccentric nasal development are near relatives of the Langurs. The first of these, which has been known in Europe since 1781, is an inhabitant of Borneo, where, be it observed, there are also true Langurs with normal noses. As may be seen from our figure (1), which represents a male in the Natural History Museum, the Proboscis Monkey, as the species is called, is characterised by the inordinate length of the nasal organ of the adult male, which projects several inches in front of the line of the mouth, and gives to the whole physiognomy a most grotesque appearance. So remarkable, indeed, is the face of this monkey, that the first view of a stuffed specimen suggests to the beholder that it has been "faked," after the fashion of the "bogus" animals formerly manufactured by our Japanese friends. The nostrils are situated on the under surface of the tip of this ungainly proboscis, and are separated from one another by an extremely narrow partition. In the case of the female the degree of nasal development is considerably less; and in the young of both sexes the nose is comparatively short, with the nostrils visible from the front, instead of being directed downwards. In point of size the Proboscis Monkey is a comparatively large animal, the length of the head and body of the adult male being about thirty inches, and that of the tail some three inches less. Its colour is likewise conspicuous and striking, the upper parts, with the exception of a light band across the loins, being brilliant chestnut, and the face, which is fringed with long yellowish hair, a reddish flesh-colour.

Far more brilliant in colour is the first of the two Tibetan species which exhibit the opposite type of nasal eccentricity in the Langur group. But these snub-nosed monkeys, as they may be appropriately called, are fully as large as the Bornean species, and as they are of much stouter build, both as regards body and limbs, they look considerably bigger. Instead of a proboscis-like development of nose these two very peculiar monkeys have their nasal organs bent suddenly upwards at a sharp angle to

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I.—PROBOSCIS MONKEY.

II.—SNUB-NOSED MONKEY.

A CONTRAST IN NOSES.

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the line of the face, so that the nostrils are fully visible from the front; the whole aspect of the face being curiously piquant. The species here figured—the Orange Snub-nosed Monkey—was first made known to European science by the French missionary, Abbé David, who obtained specimens while travelling in the province of Moupin, in Eastern Tibet. Some of his specimens are preserved in the Zoological Museum at Paris; and the coloured plate of a female has long been the only figure available to naturalists. Thanks, however, to an energetic English naturalist resident in China, the Natural History Museum has recently acquired a pair of these hitherto little-known monkeys; our figure being taken from the male, which has been mounted for exhibition, and will form one of the most attractive specimens in the large monkey case. Since our photograph does not attempt chromatic effect, it is necessary to mention that the general colour of the upper parts is rich olive-brown, flecked with yellow and suffused with rufous, while the sides of the face, the lower part of the forehead, and the under parts are brilliant yellowish-orange, tending to full orange on the face, the naked portions of which are pale blue. Across the loins there is a light patch comparable to that of the Proboscis Monkey; the tail being proportionately rather shorter than in the latter, with a distinct tendency towards a club-shape. Altogether, the appearance of the animal is highly peculiar, both from the point of view of form and of coloration. The head, for example, in addition to its "tip-tilted" nose, is noticeable for its extreme massiveness, which gives an almost leonine appearance. And this general massiveness is equally observable in the limbs, which are relatively shorter than in the true Langurs; the feet being especially heavy and broad, with their toes almost concealed by long hair.

And here the attention of the reader may be directed to the circumstance that animals inhabiting cold countries (and Sze-chuan, where the British Museum specimens were obtained, can be very cold) are almost always much more heavily and substantially built than their relatives from warmer climes. An excellent instance of this phenomenon is afforded by the case of tigers in the same collection; the Bengal tiger being a long lanky beast, while its cousin from Mongolia is a heavily built creature, with extraordinarily massive limbs. Of course the longer hair of the Central Asiatic animal tends to exaggerate its general massiveness, which, however, would be perfectly apparent even without this extraneous aid. Possibly a stout and heavy build, especially as regards the limbs, may aid in protecting the circulatory system from the effects of extreme cold.

As regards the habits of the Orange Snub-nosed Monkey, our information is of the most meagre description. These animals are stated, however, to congregate in troops of considerable size, and to ascend the tallest trees (the part of Tibet they inhabit being more or less wooded) in search of fruits, which they much prefer to leaves. When pressed by hunger, leaves and the tender shoots of bamboo are said to form their staple nutriment. Bearing in mind this alleged partiality for fruits, it would be most interesting to determine whether the stomach of these monkeys is as complex as that of the true Langurs.

In view of the recent acquisition by the British Museum of the first specimens of the Orange species of Snub-nosed Monkeys ever seen in the country, it is not a little curious that it was last year that the professors of the Paris Museum were enabled to publish, with excellent coloured plates, the description of a new species of the same group, also coming from Tibet and the adjacent districts of North-western China.

This new species, which may be popularly known as the Slaty Snub-nosed Monkey, is fully as large as its more brilliantly-coloured relative, which it also resembles in the form of its nose. The tail is, however, much more bushy, and long-haired throughout. And while the colour of the upper parts and outer and front surfaces of the limbs is dark slaty-brown, the cheeks, under parts, and thighs are mostly pure white; the naked portions of the face being flesh-coloured.

The specimens of the slate-coloured species in the Paris Museum were obtained in the north-west extremity of Yun-nan, on the left bank of the River Mekong, in the neighbourhood of Yerkalo, and it seems evident that the species inhabits the crest of the long range separating the valley of the Mekong from that of the Yang-tsi-kiang. During the summer it is probable they frequent that side of the range which overlooks China, while their winter quarters would appear to be the side directed towards Tibet. The native name of *Tchru-tchra*, or snow-monkey, sufficiently indicates the severity of the climate of the region they inhabit. Probably the Blue River forms the line of division between the distributional areas of the slaty and the orange species, the latter being found in southern Kansu, northern Sze-chuan, and Moupin.

Despite their long isolation from the sphere of European science, one, if not both, of these peculiar monkeys seems to have been known to the Chinese from time immemorial, for in a work entitled *Shan-Hoi-King*, or "Mountain and Sea Record," which has been supposed to date from more than two thousand years B.C., a so-called man of the Heu Yeung kingdom appears, from its tip-tilted nose, to be one or other of the species under consideration.

In the foregoing remarks we have treated the three species of monkeys with eccentric nasal development merely as zoological curiosities. But it will be evident to every thinking mind that there must be a reason for such strange departures from the normal, and until we discover such reason we cannot be said to know anything worth knowing about these animals. Unfortunately, those who have had the opportunity of seeing these monkeys in their native haunts have not assisted us in this matter; and as neither the Proboscis Monkey nor the Snub-nosed Monkeys have, we believe, hitherto been exhibited in confinement, there is an absolute lack of information in regard to this all-important point. And that the problem cannot be solved by guessing on the part of the stay-at-home naturalist may be regarded as practically certain. At the present day, owing partly to the anxiety to describe new species, and partly to the desire to obtain specimens of every animal for our museums, there appears a great tendency for intelligent explorers and travellers to degenerate from field naturalists into mere collectors. And the pity of this is too obvious to need more than mention. It is indeed often said that it is most important to obtain specimens of species before they become extinct; but the discovery of the *raison d'être* of the tip-tilted nose of the Tibetan monkeys, or of the proboscis-like organ of their Bornean cousin, would be a thousand times more valuable than the acquisition of untold specimens of either. And even the recently-acquired knowledge of the existence of the second species of Snub-nosed Monkey pales into unimportance when contrasted with the unsolved problem. By all means, then, let all those who have the opportunity put mere collecting into a very subsidiary place, and devote all their energies to the solution of problems of this nature (and their name is legion) before it becomes for ever too late.

After what has been said as to the necessity of actual observation to determine the reason for the peculiar nasal development of these monkeys, it would obviously be out

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of place to attempt to solve the problem in any other way. Attention may, however, be directed to the circumstance that the Chiru, or Tibetan antelope, has a remarkably swollen and puffy nose. And although the Saiga antelope, of the plains of Central Russia, has an equally remarkable nasal development, yet it seems highly probable that in the case of the Chiru, at any rate, the enlarged size of the nasal chamber and nostrils is correlated with the rarefied atmosphere of the elevated plateau on which that ruminant dwells. The Snub-nosed Monkeys, although living at a considerably lower elevation than the Chiru, are yet "well up in the world"; and since the shape of the nose in the former would appear designed to admit the passage of as much air as possible with the least impossible impediment, the suggestion that the habitat has something to do with the nose-structure may perhaps be suggested. As to the reason for the genesis of the ungainly proboscis of the Bornean monkey, we have not even the rudiment of a theory to offer our readers.

SOME SUSPECTED VARIABLE STARS.

By J. E. GORE, F.R.A.S.

THERE are many stars which have been suspected of being variable in their light, but which have not yet been admitted into the ranks of "known variable stars." The following are some of the most remarkable and interesting cases.

The brilliant star Capella (α Aurigæ) was suspected of variability by Struve, who, in a letter to Sir John Herschel in 1838, stated that he considered Capella was increasing in brightness, and Sir John Herschel agrees with him.* From observations made in 1855 by Mr. Benedict Ellner, of Bamberg, Bavaria, he found that Capella varied in brightness (1·0 to 1·9), and also in colour—from whitish-yellow to red. In the *Monthly Notices* of the Royal Astronomical Society for November, 1859, observations on the brightness of Capella are given by J. B. Kearney, of King's School, Canterbury. From February to April, 1858, he found Capella equal to Vega. Between November, 1858, and August 1859, Capella seemed rather brighter than Vega, but on August 19, 1859, "Capella was brighter beyond all possibility of doubt than either Arcturus or α Lyræ. At 10 o'clock Capella was magnificent, very far surpassing all its rivals. It flashed all manner of colours, blue and crimson being perhaps the most striking." On September 9th, 1859, he considered Capella *slightly* first, Arcturus a good second, and Vega, though *very* bright, third. My own observations, 1883 to 1886, make Capella sometimes brighter than Arcturus, and sometimes distinctly fainter. Capella was measured 0·08 at Oxford and 0·18 at Harvard, or nearly one magnitude brighter than an average star of the first magnitude.

Sir John Herschel found Arcturus brighter than Capella on April 14th, 1838.† It was measured 0·31 magnitude at Oxford (1882-1883), and 0·03 at Harvard. My own observations, as already stated, make Arcturus sometimes brighter and sometimes fainter than Capella, but the brilliancy of the stars and their distance apart render observations difficult and uncertain.

Canopus (α Argus).—This fine star—second only to Sirius in brilliancy—does not rise above the English horizon. In the Chinese Annals it is called Laou Jin, "the Old Man." Webb says, "It was thought, 1861, in Chili brighter than Sirius." Although it attained a meridian altitude of only seven degrees at my station in the Punjab, I observed it in 1874 to be very little inferior to Sirius. It was measured with the meridian photometer by Prof. Bailey at Arequipa, Peru, and found to be −0·96 magnitude, or about one magnitude brighter than the zero magnitude, that is about one magnitude brighter than Capella. As Sirius was measured −1·43 with the same instrument at Harvard, the result found by Prof. Bailey would make Canopus only about half a magnitude less than Sirius. It is certainly a splendid star, and may perhaps be variable to some extent, but owing to its great brilliancy suitable comparison stars are not available.

The star β Leonis, or Denebola, is almost certainly variable in light, but the period may be one of many years. It was rated 1st magnitude by Ptolemy, Al-Sufi, and Tycho Brahe, 1½ by Flamsteed, 1½ by Hevelius, but only 2nd magnitude by Lalande, Argelander, Heis, and others. In Schjellerup's translation of Al-Sufi's "Description of the Heavens" (tenth century) the star is thus described, "La 27 (β) de la première grandeur est la brillante et grande qui se trouve sur la queue; elle suit la brillante vingtième etoile située dans la reins. C'est celle que l'on marque sur l'astrolabe et que l'on nomme *dzana al âsad*, la Queue du Lion." Al-Sufi uses exactly similar words in describing Regulus (α Leonis), and, considering the great accuracy of all Al-Sufi's descriptions, it seems certain that in those days Denebola was fairly comparable in brightness with Regulus. The Arabians also called Denebola *al-sarfa*, "the vicissitude," possibly with reference to fluctuations in its light. Sir William Herschel, who made careful observations of the relative brilliancy of all the brighter stars in the Northern Hemisphere towards the close of the eighteenth century, rated Denebola as slightly less than γ Leonis, but slightly brighter than δ, or, in his notation 41 (γ), 94 (β) (denoting that γ was "the least perceptible difference" brighter than β). He says,* "this expression can certainly not be changed to 94, 41; much less can the order of three such stars as 20, 40, 39 Libræ admit of a different arrangement. If ever the state of the heavens should be such as to require a different order in these numbers, we need not hesitate a moment to declare a change in the brightness of one or more of the stars that are contained in the series to have taken place." Herschel's estimate of the relative brightness of β and γ Leonis is now certainly changed, as will be seen presently. Herschel says, further, with reference to β Leonis, "From the expressions of this catalogue, it is evident that the star is less now than it was thirteen years ago. The magnitude of this star given by Flamsteed is 1·2, but, as there is some ground to admit that this magnitude, even in this coarse way of reference, may be distinguished from what the same author seems to have taken for 2 mag., we conclude that this star has probably lost some of its former brightness." Again, he gives Beta 1·2 mag., and Gamma 2 mag. This notation seems to imply that Beta is larger than Gamma, which, not being the case, we have additional reason to suspect a change. De la Caille puts down Beta as 2 mag., though the difference between the notation of Flamsteed and the latter author can add little force to the argument for a change, as we have observed before, that a considerable allowance must be made for nominal variations in different authors. Nor can we draw any support from the magnitude itself, because the star will pass very well for one of that order when compared with other stars which are marked 2 mag. by the same author; but when De la Caille marks Beta 2 mag. and Gamma 3 mag., we may conclude that he estimated Beta to be larger than Gamma, though we do not know that he compared these stars

* "Cape Observations," p. 350. † *Ibid.*, p. 325.

* *Philosophical Translations of the Royal Society, 1796.*

together, because a whole magnitude in the second class cannot well be mistaken, coarse as is the type to which the reference is made." Sir John Herschel, while at the Cape of Good Hope (1834—1838), estimated β Leonis as 2·63 mag., and γ 2·34, or γ distinctly brighter than β. In recent years, β was measured with the "wedge" photometer at Oxford as 2·07, and with the meridian photometer at Harvard (U.S.A.), 2·23, γ Leonis being 2·12 at Oxford and 2·24 at Harvard. These results make the stars nearly equal in brightness; but my own observations show that β is now distinctly brighter than γ. The difference is conspicuous at a glance, and is unmistakable; and I can assert with confidence that if γ Leonis was ever brighter than β, as expressly stated by Sir W. Herschel, one of the stars is most certainly variable. In February, 1885, and March, 1887, I found β perceptibly brighter than γ; January 17th, 1889, β distinctly brighter than γ, and not very much inferior to Regulus—perhaps not more than half a magnitude; February 27th, 1889, β about a quarter magnitude brighter than γ, although β was at a lower altitude; April 14th and 17th, 1890, β nearly half a magnitude brighter than γ, although β was lower in the sky at the time of observation. At present β is distinctly brighter than γ. In February and March of the present year I found β, on several occasions, three or four steps brighter than γ, and my observations were confirmed by Dr. Kelly, of Blackrock, Co. Dublin—an experienced and accurate observer of variable stars.

δ Ursæ Majoris.—This is the faintest of the well-known seven stars forming the Plough, or Charles' Wain, and has been long suspected of variation, as it was rated of the 2nd magnitude by Tycho and the Prince of Hesse, while Sufi and Argelander give it 3-4 ($3\frac{1}{2}$), Bradley 3, and Heis 4-3. It was measured 3·41 at Oxford and 3·41 at Harvard. On December 7th, 1888, I found it equal to κ Draconis and slightly brighter than α Draconis. But α Draconis has also been suspected of variability, as it was rated 2nd magnitude by Tycho Brahe, Hevelius, Bradley and Flamsteed; 3rd magnitude by Ulugh Beigh, and only 3-4 by Ptolemy, Sufi, Argelander, and Heis. With reference to δ Ursæ Majoris, Schönfeld remarked, "Hinlänglish bestätigt, lange Periode." The period must be long, as it has not varied much in brightness for many years. Some of the other stars in the Plough have been suspected of variable light. Sir John Herschel, in 1838, thought that ε was the brightest of the seven, but in 1847 he found η *facile princeps*. Franks, in 1878, found ε decidedly the leader, and the sequence $\varepsilon, \eta, \zeta, \alpha, \beta, \gamma, \delta$. According to the Oxford photometrical measures the sequence is $\eta, \varepsilon, \alpha\ \zeta\ \beta, \gamma, \delta$, and according to the Harvard measures $\varepsilon, \alpha, \eta, \zeta, \gamma, \beta, \delta$. On the evening of November 3rd, 1898 (6.45 p.m.), in a clear, moonless sky, I found, by a very careful estimate, the following sequence:—$\alpha = \varepsilon, \zeta, \eta, \beta, \gamma, \delta$; but as the brightest stars of the set are so nearly equal in brilliancy, it is difficult to decide which, if any, are really variable.

α Hydræ.—This reddish star, called by the Arabians *al-fard*, "the solitary one," owing to its isolated position in the heavens, south of the sickle in Leo, was called "Choo'Neaon," the red bird, in the Chinese Annals, and is spoken of as red by Sufi. Sir John Herschel suspected variation in its light, and says ("Cape Observations," p. 349): "At the time I regarded the observations as satisfactory, and the results as sufficiently established; but the occurrence of a similar phenomenon with a period nearly identical in the case of α Cassiopeiæ, the period in each case being nearly a lunation, inclines me to distrust both conclusions, and to believe that the colour of the stars (in both cases verging to redness) has affected the judgment in the presence of moonlight differently from that of the stars of comparison." As, however, α Cassiopeiæ has since proved to be really variable, it seems probable that α Hydræ may be variable also. Gemmill observed it to be very bright on February 20th, 1882, and its red colour very conspicuous. He found it again remarkably bright on May 9th, 1883, when he thought it nearly equal to Pollux. It was measured 2·22 at Oxford and 2·02 at Harvard.

β Ursæ Minoris.—This star was rated of the second magnitude by Ptolemy, Sufi, Argelander, and Heis. In the "Cape Observations," Sir John Herschel gives observations of this star and concludes that it is certainly variable with a period of perhaps over ten years. From observations in 1881 and 1882, Espin thought it variable from 2·2 to 2·8 magnitude with a period of about 10·67 days. His observations were confirmed by Read, but the star has not yet been admitted into the ranks of known variables.

λ Draconis.—I have long suspected this star of variability, as my own observations, 1876 to 1891, show decided fluctuations of light. Sir William Herschel found it *exactly equal* to κ Draconis. On January 30th, and February 17th, 1876, I noticed that it was a little less than κ, and on the latter date I rated it 4th magnitude, and its colour orange. On January 12th, 1877, I found λ slightly *brighter* than κ, but on December 13th, 1878, I recorded it as a $\frac{1}{4}$ magnitude *fainter* than κ. Observations in subsequent years make it always less than κ, and on January 24th and 26th, 1889, I found it six steps, or about $\frac{3}{4}$ magnitude less than κ. On February 2nd, 1899, I found λ nearly one magnitude fainter than κ. Either λ or κ is therefore probably variable, and it seems more probable that λ is the variable, as its colour is orange and many of the reddish stars are known variables.

θ Serpentis.—This star was rated 4th magnitude by Ptolemy, Sufi, Ulugh Beigh, Lacaille, and Pigott; but 3rd magnitude by Tycho Brahe, Hevelius, Bayer, Flamsteed, Bradley and de Zach. Piazzi and Smyth made it $4\frac{1}{2}$, and Montanari called it 5. The Cordoba estimates vary from 4·1 to 4·6, and Dr. Gould thought there were strong indications of variability in one of the components (it is a double star). He gives the magnitudes as 4·5 and 4·7, but on one occasion at Harvard a difference of 1·4 magnitude was noted.

(To be continued.)

THE NEW ALGOL VARIABLE IN CYGNUS, +45° 3062.

AN announcement is made in the *Astronomische Nachrichten*, Vol. 149, p. 271, that the star +45° 3062, R.A. = $20^h\ 2{\cdot}4^m$, Dec. = +45° 53′ (1855), magn. 8·6, is a variable star of the Algol type. Mme. L. Ceraski, of Moscow, found it abnormally faint on a photographic plate taken on May 20, 1898, and M. S. Blajko, after observing it visually for a long time, found it again at minimum on May 7, 1899. An examination was accordingly made of the Draper Memorial photographs to determine the nature of the variation. The region was covered by one hundred and ninety-five plates, one hundred and seventy of which showed the star at its full brightness, and twenty when it was below its normal brightness. From a discussion of these plates it appears that the minima they indicate, as well as the two minima found at Moscow, may be closely represented by the formula J. D. 2,411, $343^d{\cdot}605 + 4^d{\cdot}57294$ E. The period, therefore, is $4^d\ 13^h\ 45^m\ 2^s$, with an uncertainty which probably does not exceed one or two seconds. The variation in brightness of this star amounts to about three magnitudes, and, therefore, exceeds that of any Algol star hitherto discovered. Like all other Algol stars, its spectrum is of the first type.

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The announcement of the discovery of this variable reached this Observatory on June 1. On June 3, the elements and ephemeris had been determined just in time to prepare for the minimum of that night. Accordingly, the star was followed all night by Prof. Wendell, assisted by Mr. Leon Campbell, and two hundred and seventy-two settings were made with the photometer attached to the fifteen-inch equatorial. From these it appears that at $16^h{\cdot}0$ G. M. T., it was 0·20 magnitudes brighter than the comparison star, +45° 3067, while at $19^h{\cdot}9$ G. M. T., when observations were stopped by the dawn, it was 2·25 magnitudes fainter than the same comparison star, although it was still $1^h{\cdot}5$ before the predicted minimum. Observations by Argelander's method were also made all night by Mr. Wm. M. Reed, with the six-inch equatorial. Meanwhile, thirty photographic images were obtained by Mr. H. R. Colson, assisted by Mr. E. R. Cram.

Nearly a year would have been saved had the original discovery of the variability of this star been sent here for confirmation from the photographs, or had it been announced publicly. There is so little chance for error in a photograph that such cases are always examined here. Confirmation is not always obtained. A striking instance of this kind is furnished by a photograph, X 7524, taken at Arequipa with the thirteen-inch Boyden telescope on May 22, 1896, at $14^h\ 20^m$ G. M. T. Miss A. J. Cannon found that this plate shows the spectra of A. G. C. 17312, 17407, and 17453, magns. 7·0, 7·2, and 7·5 respectively, but fails to show the spectrum of the brighter star A. G. C. 17270, magn. 6·0. Apparently this is an Algol star observed at one minimum only. On one hundred and fifty-three other plates the star appears of its normal brightness. On a photograph, C 7354, taken at Cambridge with the eleven-inch Draper telescope on December 18, 1894, at $11^h\ 8^m$ G. M. T., the star, +42° 4182, magn. 9·1, was found by Miss L. D. Wells to be absent, although stars two and a half magnitudes fainter were shown. On plate C 7353, taken twelve minutes earlier, and on two hundred and fifty-nine other plates, it appears of its normal brightness. An adjacent defect in the film of the first plate is perceptible, and perhaps explains the absence of this star. EDWARD C. PICKERING.

Harvard College Observatory,
June 10th, 1899.

[A minimum is predicted for the new variable 17^m before midnight on August 11th, and again 2^m before midnight on September 12th.]

British Ornithological Notes.

Conducted by HARRY F. WITHERBY, F.Z.S., M.B.O.U.

MISTLE THRUSH SWALLOWING DROPPINGS OF YOUNG.—I can endorse what Mr. East says about the Mistle Thrush. As in his case, a nest was built this year near my study window, easy of observation. There were three young ones, and, up to the time of leaving the nest, the old bird always swallowed the droppings. That she did not disgorge them, for some time at any rate, was evident, as she would often brood the young ones for several minutes before taking flight again. While she was sitting I noticed the cock bird pay her an occasional visit. She then perched on the edge of the nest, into which he disgorged some food and flew away. After eating at her leisure she resumed her duties.—GEORGE J. CHAPMAN, M.A. (OXON.), F.Z.S., Carlecotes, Dunford Bridge, Sheffield, June 20th, 1899.

All contributions to the column, either in the way of notes or photographs, should be forwarded to HARRY F. WITHERBY, *at 1, Eliot Place, Blackheath, Kent.*

Science Notes.

Sir John Donnelly, who has just retired from the secretaryship of the Science and Art Department, and is succeeded by Sir George Kekewich, has during the forty years of his public service performed an amount of good work, the far-reaching effects of which will be better realised a generation hence, perhaps, than at present. Those who are best acquainted with his history do not hesitate to say that the present effective system of scientific instruction throughout this country is due almost entirely to Sir John's organizing ability and untiring efforts. A great friend of Gordon's from their student days at the Royal Military Academy, he was very near joining that hero in China when he commanded the "ever-victorious" army. When Gordon was Governor-General of the Soudan he invited his friend to join him, with a view to succeed him. All was settled to that effect, but, at the last moment, Sir John was induced to remain at home; the transference of his attention from military to civil problems has been a great factor in those innovations which have secured equal chances to all classes for the acquisition of sound instruction in Science and Art subjects.

The interesting collection illustrating the coinage and currency of the Chinese Empire, brought home by Lord Charles Beresford from his recent mission to China, has been generously lent by him to the Victoria and Albert Museum, South Kensington, and is placed in the Chinese Section in the Cross Gallery behind the Imperial Institute. It includes a series of silver taels in the form of cast ingots in the rough, with a pair of scales with brass and ivory weights for estimating the value, and some fragments used as small change. There is a set of dollars of different nationalities which pass in China, among them being the new British dollar, first issued in 1898 and coined in India. Among the copper coinage is a collection of ten thousand cash, strung together in bundles by means of the central hole which is a characteristic of Chinese copper coins, representing £1 in English money.

A novel camera, designed so as to admit of approaching quite near to any subject it is desired to photograph without betraying the purpose of the operator, has just been introduced by Messrs. W. Watson and Sons. It is in the form of a binocular field-glass. The photographer, ostensibly looking at an object in the direct line of vision through dummy object glasses, really operates on unsuspicious people at right angles—to the left or right—by means of intercepting prisms which divert the incident rays round a corner, as it were. Very good results can be obtained, and the action is instantaneous.

Obituary.

SIR WILLIAM FLOWER, whose death, we regret to record, occurred on Saturday, the 1st July, was much and justly esteemed by scientific men the world over. Born at Stratford-on-Avon in 1831, after a course of study at University College, London, he entered the Army, and served in the Crimea as Assistant-Surgeon, becoming on his return home, Demonstrator of Anatomy in the Middlesex Hospital, and a year or so later, Curator of the Hunterian Museum of the Royal College of Surgeons, then Hunterian Professor of Comparative Anatomy and Physiology, and, in 1884, succeeded Owen as Director of the Natural History Museum at South Kensington. He was

elected a Fellow of the Royal Society in 1864, and received from that learned body a Royal Medal in 1882. In 1879 he became President of the Zoological Society, and presided over the anatomy section of the International Medical Congress which met in London in 1881; from 1883 to 1885 he served as President of the Anthropological Institute, and was President of the British Association in 1889, having previously acted as president of the biological section in 1878 and of the department of anthropology in 1881. Oxford and Cambridge both conferred honorary degrees upon him, and the Institute of France appointed him one of its corresponding members. In the Jubilee year, 1887, he received the honour of C.B., and in 1892 he was knighted. Sir William's best-known work is, perhaps, "The Horse: a Study in Natural History," although several other works emanated from his pen—"An Introduction to the Osteology of the Mammalia;" "Diagrams of the Nerves of the Human Body;" "Fashion in Deformity," and "Mammalia," in the "Encyclopædia Britannica," as well as many minor articles on zoological subjects in that ponderous work of reference; but a large portion of his writings remains entombed in the proceedings of the Royal Society and other learned bodies. Morphology was, however, enriched by the "Memoirs on the Brain and the Dentition of the Marsupialia," which he published in 1865 and 1867, and his papers on the "Characters of the Cranium in the Carnivora" and on the "Evolution of the Cetacea" constitute valuable acquisitions to scientific literature. Sir William stedfastly urged the importance of museums as instruments for the advancement of knowledge in two ways—by affording facilities for scientific research, and by providing the means for popular instruction; these views he put in practice during his reign at the Natural History Museum, and the innovations he introduced were attended with excellent results.

Letters.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

HONEYSUCKLE FLOWERING IN A STRANGE PLACE.

To the Editors of Knowledge.

Dear Sirs,—In a beautiful garden at Uckfield, I saw the other day a sight that rather surprised me. A dead branch had fallen from a tree into a lake. From this branch an arm stood some four feet straight out of the water. On the top of this arm has now appeared a honeysuckle, trailing some inches down. The seeds of this plant were no doubt deposited by a bird, but how does it obtain sufficient moisture to be in the healthy condition it is? Is it capillary attraction, or are long suckers shot down by the plant into the water?

Jos. F. Green.

THE DISTRIBUTION OF THE STARS.

To the Editors of Knowledge.

Sirs,—The subject of Dr. Burns's article in your July issue is one on which I have bestowed a good deal of attention. My earliest articles on it appeared in *The Sidereal Messenger* for 1888. In the first of them, I inferred that if the stars of the nth magnitude were all placed on the surface of a sphere, those of the $n+1$th would be placed on the surface of a sphere with a radius 1·585 times greater, and would, therefore, on the hypothesis of uniform distribution, be 2·512 times as numerous. I discovered and corrected my mistake before any other contributor did so, but the curious circumstance is that the wrong figure accorded much better with observation (based on photometric measures) than the right one. It was indeed somewhat too low, but the right figure was considerably too high.

Argelander's magnitudes cannot be regarded as based on the ratio of 2·512 for one magnitude, and 9·5 being the lowest magnitude mentioned in his tables, he has included under that head stars of the 10th magnitude and even below that magnitude. Our only real guide is that afforded by photometric measures, in which Pogson's scale was adopted. The various publications of the Harvard Observatory contain the best and most extensive tables at present available. But I should doubt the correctness of any measures as low as the 17th magnitude, and am not at all surprised at the apparently discordant results arrived at by Dr. Burns from an examination of them.

In my recent little book "An Introduction to Stellar Astronomy," I summarised briefly the results of my previous investigations thus: "So far as I have compared photometric measures of stars, I think the theoretical proportion of four to one for the numbers of stars of two successive magnitudes is rarely, if ever, realized. If all stars are of equal intrinsic brightness, and light varies as the inverse square of the distance, a thinning-out commences at (comparatively speaking) no great distance from the earth or sun" (pp. 38–9). And I go on to point out that if the theoretical ratio were even approached in the case of very faint stars, the total sky-light would be vastly greater than it is. Let me illustrate this by comparing the total light of stars of the 5th and the 105th magnitudes on the hypothesis of uniform distribution. The light of each star is diminished in the proportion of $1{\cdot}585^{200}$, but the total number of stars is increased in the proportion of $1{\cdot}585^{300}$ to 1. The total light is, therefore, greater in the proportion of $1{\cdot}585^{100}$ or 10^{20} to 1. Written in figures, this would be represented by 100,000,000,000,000,000,000 to 1. The collective light of the stars of the 105th magnitude would, on this hypothesis, be much greater than that of the sun, and the change made in the total amount of sky-light by the rising and setting of the sun would become utterly insignificant.

W. H. S. Monck.

THE NEBULA N.G.C. 2237-9 MONOCEROTIS.

To the Editors of Knowledge.

Sirs,—The remarkable photograph of the above object, to be found at p. 132 of the June number of Knowledge, must, I think, impress every one who sees it with the great skill of the photographer, Dr. Isaac Roberts, and the perfection to which he has reduced the portrayal of the nebulæ. But there are other considerations which have struck me while looking at this picture. The first is the enormous extent of the nebulous matter. If we assume the parallax to be, say 0·5″, which is probably far over the mark, and consequently the real distance under estimated, the diameter, or greatest linear extent (perpendicular to line of sight) of that portion of the nebula situated in the N.P. part of the whole system, comes out about two hundred and sixty-seven thousand millions of miles; or, in other words, at least forty-eight times the diameter of Neptune's orbit. But *all* the separate nebulosities shown in this picture would seem to be undoubtedly connected; and we find that the greatest extent of the whole system exceeds one hundred and twenty-seven times the diameter of Neptune's orbit. Such figures convey absolutely no idea of their reality to our minds; yet unless any one can show that the nebula is very much nearer to us than the generality of the stars, it must be conceded

that our figures are much under rather than over the mark. Mr. Maunder remarks* it is hard to understand how we can have gaseous masses of such enormous extent. They beggar our solar system in dimensions, and instead of a very few bodies of comparatively small size and condensed nature, must occupy an amount of solid space which we are quite unable to grasp.

The second feature to which I would call attention, and which Dr. Roberts in his description of the photographs specially refers to, is that of the dark rifts or lanes occurring in the nebula, especially the N.P. portion. They are sharply defined and clearly cut. How are we going to explain these dark rifts, which Mr. Maunder and others have alluded to? The breadth of one of these sharp rifts is about 1 mm., which on Dr. Roberts' scale = 24″. If the nebula is homogeneous and with a thickness in the line of sight approximately the same as that perpendicular to it, we are driven to the conclusion that this rift must be a hole, perforating the nebula from one side to another, with a length which must exceed its breadth by at least fifty times. This, as in the case of a bullet hole in the case of a terrestrial object, we might perhaps allow, if the aperture were circular; but when we come to have several of these rifts with an irregular, yet sharply-defined outline, the probability is very enormous against their being apertures extending through the nebulous matter to an extent corresponding to that of the whole system, in the line of sight.

I believe it has been suggested that such a phenomenon as these rifts may be due to the interposition of solid dark masses of matter between us and the nebula. But in the present state of our knowledge, and on scrutinizing the photograph under consideration, I cannot bring myself to believe that this is the correct explanation. The rifts do, to me, certainly appear as real vacuities, showing the blackness of space between or amongst the nebulous matter.

I can only account for them by the infinitely complicated character of this nebula. I suppose it to consist of streams and wisps, and projections of gas, bending, twisting in all directions, and by no means homogeneous when considered over the whole angular space which the nebula seems to occupy. In that case, a hole or rift is not so difficult to understand when we consider that it pierces a portion of nebula small in comparison to the whole system. Some cause or other, at present totally unknown to us, may tend to draw away or attract the nebulous fluid from certain definite but comparatively small localities and produce these gaps. The explanation, I fear, is a lame one to a certain extent, but who can offer a better? Those who have studied the writings of Proctor on this subject will probably trace his influence in this attempted explanation. He it was who said that "the constitution of the sidereal universe is too complex to be at present ascertained," and I think this remark would apply very largely to the particular nebula I have been considering. We must not think this nebula to be of the same nature as the regular spherical or elliptical ones, or the globular clusters of stars. In such I do not think such a thing as a dark vacuity exists.

It is possible that photographs taken at some future time, on a much larger scale, when the art has been greatly improved, may show these gaps or rifts to be partially occupied with, perhaps, comparatively tenuous nebular matter, just as increase in magnifying power of a (visual) telescope brings out details unexpected before. Meanwhile the rifts must remain a very remarkable feature, showing, I think, the very complicated nature of the detail which go to make up one of these irregular nebulæ. The curdlings and streaks, etc., in the great nebula in Orion are, I think, a phenomenon of an analogous order, although the general character of that nebula may differ from the one particularly under consideration.

E. E. Markwick, Col.

* Knowledge, February, 1896, p. 38.

THE ORIGIN OF FLINT.

To the Editors of Knowledge.

Sirs,—I find that, in an article on "Flint" in Knowledge for June, 1899, I have omitted mention of a comprehensive paper by Prof. Rupert Jones, F.R.S., on "Quartz, Chalcedony, Agate, Flint, Chert, Jasper," in the *Proceedings of the Geologists' Association*, Volume IV. (1876), p. 439. Prof. Rupert Jones provides an admirable historical account of the various opinions that had been held as to the origin of flint, and strongly supports the view (p. 450) that the silica is deposited as a pseudomorph of limestone. So much had been written on the subject in a more or less extravagant vein, that this paper, twenty-three years ago, produced a very salutary impression.

Grenville A. J. Cole.

THE DISTRIBUTION OF STARS IN SPACE.

To the Editors of Knowledge.

Sirs,—With reference to Dr. Burns' interesting paper on this subject in the July number of Knowledge, I find, in going through the recently published volume of measures made with the photometer at Potsdam Observatory (zone +20° to +40°), about one hundred cases in which the photometric magnitudes differ from those in the *Durchmusterung* by one magnitude and over. With only one exception in the hundred, the magnitudes given in the *Durchmusterung* are brighter than those found by the photometer. Thus, a 7·0 magnitude in the *Durchmusterung* is 8·0 or less in the Potsdam Catalogue, a 7·3 magnitude in the *Durchmusterung* is 8·3 or less, and a 7·5 magnitude star in the *Durchmusterung* is only 8·5 or less when measured with the photometer. This tends to confirm Dr. Burns' opinion that the fainter stars in the *Durchmusterung* are estimated too bright. Only stars down to 7·5 magnitude in the *Durchmusterung* were, however, measured at Potsdam.

With reference to the stars composing the Milky Way, it seems very improbable, I think, that the faintest stars lie at the distance indicated by their magnitude. For, taking stars of the 16th magnitude, their distance would be one thousand times—$(1{\cdot}585)^{15}$—that of an average star of the 1st magnitude, and with Dr. Elkin's mean parallax of 0·089″ for stars of the 1st magnitude, the parallax of a 16th magnitude star would be only 0·000089″, or a "light journey" of about 36,600 years! Placed at this distance our sun would be reduced in brightness to a star of magnitude 19·8, which no telescope yet constructed would show. I find by Pogson's formula that to *glimpse* a star of 19·8 magnitude, a telescope of 132 inches, or 11 feet, in aperture would be required.

To reduce the sun to a star of the 16th magnitude it should be removed to a distance of 398,100,000 times its present distance from the earth. This would imply a parallax of 0·000518″, and a "light journey" of over 6000 years! But the stars composing the Milky Way may very possibly be much smaller than the sun and intrinsically brighter (Sirian type), and, therefore, much nearer to us than the above calculation would indicate.

Dublin, July 10th. J. E. Gore.

Notices of Books.

An Introduction to Stellar Astronomy. By W. H. S. Monck, M.A., F.R.A.S. 1899. (London: Hutchinson & Co.) Mr. Monck has been unfortunate in his choice of a title. A more appropriate one would be "Facts and Fancies of Stellar Astronomy," and this, besides expressing more truly the nature of the essays that Mr. Monck has here reprinted in book form, would have been more likely to attract the attention of those readers to whom it would appeal. These readers should be "scientists," whom Mr. Monck in his preface distinguishes from "observers," good, bad or indifferent; and from the style of the book itself we should judge that by "scientist" he means what in the Middle Ages would have been called a "philosopher" and in the present day a "metaphysician." Still the "Introduction to Stellar Astronomy" will form a volume of comfortable reading for a philosopher in a hammock slung in a cherry orchard, if he is well acquainted with all the methods, and most of the facts and a few of the theories in stellar astronomy—or is content to remain ignorant of the first two. There is one theory, however, which we cannot pass over. It is not new, indeed, having been advocated for many years, by two or three paradoxers under the simpler term of "the sun a cold body." It is that "all loss or gain of heat," and presumably all forms of energy, is "an interchange between bodies in space, and on the whole the amounts lost and gained by these bodies would be equal." In other words, the sun only shines where there is anybody to receive its rays. We have always been ready to deplore the gross extravagance that is rife in the universe—and perhaps since economy should be practised, the sun and stars in fact take as their motto "no waste"—yet we do not see how Mr. Monck can ever hope to advance any evidence, not to say proof, on the point, since even if he could turn "somebody" into "nobody," and send it out as an immaterial spirit into the void of space, it would still be a moot question whether the lack of evidence it brought back would tend to establish that "nobody" had no eyes to see or senses to perceive, or that the sun had no rays to give forth to space.

The Internal Wiring of Buildings. By H. M. Leaf, A.M.I.C.E., M.I.M.E. (Constable & Co.) Illustrated. 3s. 6d. This is a really useful book, containing a number of minor errors which must not appear in the next edition. In speaking of the first of these errors, we would (in order to avoid a pun) suggest that Mr. Leaf should take two pages out of his book. These pages are the ones upon which definitions of the electrical units are given. It is clear in this connection that the author has attempted to break away from stereotyped expressions, and the results are not particularly happy. For example, the ampère is defined as the unit of quantity; so that one is led to ask, "What then is the coulomb?" The definition of the volt again gives no idea of electro-motive force. Yet clumsy as these definitions are, they will, we trust, do no great harm, though for Mr. Leaf's sake, it is a pity they occur so early in the book. We should like, too, to see the term C^2R spoken of sometimes as the watts lost by heating. Amongst the many interesting points brought out, we note that while many people object to the idea of bunching mains (even of like polarity) in wood casing, yet it is quite usual to draw both positive and negative leads into the same metal tube, and further, owing to the better mechanical protection afforded by such a tube, the insulation is frequently made lighter. Now all this is actually done in practice, as Mr. Leaf says, but the absurdity of it is obvious. There is a good detailed specification given, which might be copied almost verbatim (save in the matter of quantities, of course) by anyone wishing to apply it to a particular "job." Finally, while the book has its faults they are not serious, and regarded as a whole it is better than the most of those we know dealing with the subject. It is up to date, too, containing in the appendix the Institution wiring rules; also, the get-up of the book is good, but when will publishers give up printing the name of a work at the top of every page, instead of some useful sub-heading, or the chapter's title?

A Text-book of Botany. By J. M. Lowson, M.A., B.SC. (London: W. B. Clive.) 6s. 6d. This book is the latest addition to the well-known series issued from the University Correspondence College for the use of students preparing for examinations in general and those of the London University in particular. Mr. Lowson, consequently, has not had a free hand, and has not, in our opinion, done himself justice. There is no fault to be found on the score of inaccuracy; the book is well and clearly printed and also profusely illustrated; yet as a whole there is a lack of attractiveness. One cannot on a single page forget the examination. The alternation of clarendon and italics unconsciously sets one thinking—"Is this likely to be set next time?" The attention, instead of being fixed, is distracted. Then, too, the explanatory words attached to the well-drawn and instructive illustrations call up, willy nilly, the flag labels which the undergraduate associates with Burlington Gardens. What is to become of the romance of flowers and the poetry of the garden when plants are treated in this way? It is unavoidable, perhaps, that the primrose should be regarded as a dicotyledon, which is an excellent instance of heterostyly, but even the mortal who aspires to the honour of Bachelor of Science or Bachelor of Medicine might be taught, even while trying to assign it to its proper order in a system of classification, to regard a flower to some extent from the æsthetic point of view. We are finding no fault with Mr. Lowson, it is abundantly evident that he is an accomplished teacher. Under his care the candidate need have no fear of being "plucked." We complain of the examination spectre, and wonder what will be left to poor ordinary cultured beings who care nothing for titles but everything for the flowers of the field.

A History of Physics. By Florian Cajori, PH.D. (Macmillan.) 7s. 6d. net. We have histories of chemistry, astronomy, and biology—subjects which are sufficiently specific to lend themselves fairly well to historic treatment. Foundation stones are required for these literary structures, and they are all delved out of the mines of heterogeneous learning of the Greeks. Anyone who has indulged in this sort of intellectual diversion knows how the several sciences grow out, so to speak, from a main stem—the beginning of each history is almost identical in each case, and it is only after repeating the same old story that the subject begins to acquire individuality. Dr. Cajori, of course, resorts to the same sources as all the others, but his subject instead of developing into a distinct personality, as it were, becomes a kind of a many-headed monster—sound, light, heat, electricity, magnetism, mechanics, meteorology, atomic theory, and the evolution of physical laboratories. We ourselves are at one with Professor Ostwald where he says:—"Eminent and far-sighted men have repeatedly been obliged to point out a defect which too often attaches to the present scientific education of our youth. It is the absence of the historical sense, and the want of knowledge of the great researches upon which the edifice of the science rests." True, but we want something approximating to continuity in the history of, say, sound; to read one or two pages of matter concerning the progress of a subject during the sixteenth century, followed by similar scraps on many other subjects, to form a chapter for that particular period, and then repeat the same process for each succeeding century is a kind of scientific switchback railway which is more depressing than exhilarating. It is remarkable, too, that this book should have ever seen the light at all in its present condition—so thoroughly incommensurate with the magnitude of the project; the author, it is fair to say, appears to be conscious of this defect, but here it is nevertheless—not even a good skeleton for future clothing, at any rate according to our way of thinking. Here are from sixty to seventy thousand words in the book, and with this slender expenditure of printed matter "it is hoped that the survey of the progress of physics here presented may assist in remedying this defect so clearly pointed out by Professor Ostwald."

A New Astronomy. By David P. Todd. (Sampson, Low, Marston and Co., London.) Prof. Todd's leading thought in preparing this attractive little manual has been that it is possible to teach much of the principles and a good many of the facts of astronomy by what may be termed "laboratory work," that is to say, by practical work of a kind that is within the reach of nearly everyone. It is this principal that justifies Prof. Todd in calling his book a *New* Astronomy, for it differentiates it from the great majority of manuals dealing with the same general subject. The idea is an excellent one, and it has been admirably worked out with much ingenuity and freshness of thought. Lowell's work on Mars and Venus, Hale's

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spectroheliograph, Deslandres' discoveries in the spectrum of Altair, Lockyer's Meteoritic Theory, Chandler's Wandering of the Pole, and other recent developments, are all noticed, so that the book is fully up to date. For so small a book, indeed, it is very remarkably complete, and the explanations of principles or difficulties, though brief, are usually very clear. Lastly, especial pains have been taken with the illustrations, which are very numerous and good. Many of these are decidedly novel and striking. Thus in the two illustrations of the chief circles of the horizon equator and ecliptic systems, the different lines and curves are not lettered or numbered for reference, but are most distinctly labelled. So, too, with the telescopes. We must, however, object to the picture of the zodiacal light on p. 351, as utterly unlike the subject it professes to represent, whilst on p. 308 he has fallen into the inexcusable mistake of representing the eclipsed moon as 5° in diameter.

Smithsonian Institution. Report by S. P. Langley, for the year ending June 30th, 1898. Since the establishment of the Smithsonian foundation at Washington, in 1846, scientific research in America has progressed steadily, and the long series of publications issued have been the chief means of spreading the fame of the institution, the buildings of which are fine, and contain the national museum, and a good library, as well as the Library of Congress. In this report, Prof. Langley gives us an outline of the operations of the institution during the year ending June 30th, 1898, including the work placed under its direction by Congress in the United States National Museum, the Bureau of American Ethnology, the International Exchanges, the National Zoological Park, and the Astrophysical Observatory. The permanent funds of the Institution are as follows:—

Bequest of Smithson, 1846		$515,169·00
Residuary legacy of Smithson, 1867		26,210·63
Deposits from savings of income, 1867		108,620·37
Bequest of James Hamilton, 1875	$1,000·00	
Accumulated interest on Hamilton fund, 1895 ...	1,000·00	
		2,000·00
Bequest of Simeon Habel, 1880...		500·00
Deposits from proceeds of sale of bonds, 1881 ...		51,500·00
Gift of Thomas G. Hodgkins, 1891		200,000·00
Portion of residuary legacy, T. G. Hodgkins, 1894		8,000·00
Total permanent fund ...		912,000·00

The first grant made by the Institution for scientific exploration and field research was in 1848, to Spencer F. Baird, of Carlisle, for the exploration of the bone caves and the local natural history of south-eastern Pennsylvania. In recent years a vast amount of such work has been carried on by the bureaus—a work made possible by Congressional appropriations for this purpose. The works published and circulated during the last fifty years form a library of about two hundred and fifty volumes. In 1887 the institution sent out seventy-one tons of documents, and had two thousand one hundred and sixty-five correspondents at home and seven thousand three hundred and ninety-six abroad; during the past year it transmitted one hundred and fifty-one tons, and had six thousand nine hundred and fifteen correspondents at home, and twenty-two thousand five hundred and forty-three abroad. Indeed, the system of international exchanges is the most powerful factor of the Smithsonian Institution for carrying out efficiently the beneficent purpose of its founder—to diffuse knowledge among men.

The Essex Naturalist. Edited by Wm. Cole, F.L.S., F.E.S. (Essex Field Club, Buckhurst Hill, Essex.) 6s. per annum. We have before us the parts of Vol. X. of this excellent publication, a work which is almost wholly local, *i.e.*, devoted to the elucidation of the natural history, geology, and pre-historic antiquities of the county of Essex. The Essex Field Club is about nineteen years old, and has already published some eighteen volumes of "Transactions" and "Special Memoirs." As might be expected, the subjects dealt with touch on every phase of the outdoor world as seen in the county of Essex—boring in search of coal, food of oysters, notes on the Epping Forest species of mycetozoa, floral aspects of the forest, fungi and how they should be represented in the local museums, fresh-water algæ, protection of birds, tides on the coast, ancient defensive earthworks, soils and subsoils, and so on. Indeed, whatever can in any way contribute to the economic or social welfare of the county is assured of a place in this little magazine, which is occasionally very well illustrated.

Researches into the Origin of the Primitive Constellations of the Greeks, Phœnicians and Babylonians. By Robert Brown, Junr., F.S.A., M.R.A.S., &c., &c. Vol. I. (Williams & Norgate, London, Edinburgh and Oxford.) 1899. Mr. Robert Brown, Junior, is George Eliot's Mr. Casaubon with a difference. The "Key to all the Mythologies" never took concrete form within the covers of a printed volume. Mr. Brown is more energetic than his fictional prototype, and his version of the "Key" reaches its fifteenth *avatar* in the present volume. But the scholarship, the industry, the essential and ostentatious pedantry and the complete obsession of the man by a single theory are characteristic equally of the real as of the imagined writer. Yet with all this, it is beyond dispute that Mr. Brown's books, and the present one in particular, have a very high value. In spite of page after page filled with matter which is really irrelevant, and which seems to have been simply introduced in order to impress the reader with a proper sense of the amazing learning of the author; in spite of continual repetitions which confuse rather than help, and of an arrangement far from well considered, the present book stands out as the most serious and scientific attempt yet published to trace the old constellation figures back to their origin. Mr. Brown traces the primitive constellations of the Greeks—those, that is to say, that are described for us in the *Phainomena* of Aratos—back to the early inhabitants of the Euphratean Valley, and particularly to the Akkadians, from whom the Greeks derived them through the Phœnicians, the Hittites, and the later (Semitic) Babylonians. This opinion Mr. Brown has set forth again and again in his earlier books, but though his details and repetitions are wearisome and often wholly unnecessary, there can be little doubt that, so far as there is evidence at present available, he proves his point. The question is different when he enters on the signification of the constellations. Here only one answer is regarded as admissible. Every constellation, without exception, is simply a special case of the great solar myth. So sweeping and so simple an explanation is self-condemned, and indeed we find that most of his interpretations of the signs of the zodiac assume that they were mapped out when Aries was the equinoctial sign, yet he is careful to point out (p. 327) that the present arrangement was adopted when the sun still entered Taurus at the vernal equinox. The fact is that many of the myths with which Mr. Brown deals were clearly originated at a relatively late date in order to account for the signs, the origin of which had then been forgotten, instead of the process being the reverse. It would be unjust, however, to enlarge too much upon the faults, glaring though they may be, of a writer who has made a real advance in a difficult subject. But we cannot conclude without a reference to the perversity with which Mr. Brown forces his ideas of the correct orthography of familiar proper names upon us at every turn. One single page supplies us, beside five synonyms for Babylon, with the following: Dârayavaush, Nabukudurra-utsur, Qarth-Hadasth, which we are kindly informed either here or elsewhere are meant to represent Darius, Nebuchadnezzar, and Carthage, and we are tempted to exclaim with honest old Hugh Evans, "The tevil and his tam! what phrase is this? why it is affectations."

Stonyhurst College Observatory; Results of Meteorological and Magnetic Observations for 1898. Father Sidgreaves' Report presents its usual neat and clear appearance, and as an ardent meteorologist he has the happiness on this occasion of establishing a record, the month of January being the warmest January in the Observatory annals. The appendix, which gives the meteorological observations taken at St. Ignatius' College, Malta, furnishes a less pleasant record for October. No readings of the ground thermometers were taken in that month from the 20th to the 30th inclusive. The reason for this omission is not expressly stated, but a suggestive account of a hailstorm on the 19th, with hailstones as large as hen's eggs, which crashed through wooden venetians, and pierced through corrugated roofs, is appended in a footnote. A useful little table of dates of magnetic disturbances is given on p. 50, but Father Sidgreaves concludes that there is at present no clear law connecting the magnetic disturbances with the sunspot areas of the year.

The Scientific Roll and Magazine of Systematized Notes, conducted by Mr. Alexander Ramsay. This work is to be completed in sixteen numbers. It embraces (1) a *bibliography*, classified according to subjects arranged (*a*) under year of publication, and (*b*) alphabetically as to authors, and each item has its number for reference purposes; (2) an *index*, which, although arranged alphabetically, is classified in groups

more than is usually the case, the object being to render it possible, at some future time, to amalgamate the various subject-matter indexes into one general index; (3) a *systematized collection of facts*, grouped with reference to their relation to each other. The aim of the whole is to enable any person engaged in scientific research to find the information he seeks with a minimum expenditure of time. The information does not extend to science in general, but is confined to Climate and "Baric condition."

Rousdon Observatory, Devon; Variable Star Notes. No. 4: *R Cygni and* χ *Cygni.* As is well known, Sir C. E. Peek makes the observation of variable stars his speciality, and in this, the fourth issue from his Observatory in Devonshire, he gives the observations and curves of R and χ Cygni. The inspection of the curves brings to light the remarkable coincidence—it can be no more—that the light variations of the two stars seem complementary. The mean curve of the two stars indeed would be very nearly a straight line.

Curious Epitaphs. Compiled and edited, with notes, by William Andrews. (Andrews & Co.) 7s. 6d. This is a reprint, with some important additions, of the interesting collection of epitaphs first published by Mr. Andrews some years since. In terseness, wit, and perspicuity, it is hard to beat Jerrold's anticipatory epitaph on Charles Knight, the distinguished historian: GOOD KNIGHT.

Coleridge's Table Talk. The Bibelots. Vol. I. Edited by J. Potter Briscoe. (Gay & Bird.) 2s. 6d. We do not recall a more elegant and altogether dainty little volume. Beautiful types and good paper, embraced in embossed calf, with gilt edges, make up an exquisite possession for the book lover.

The International Directory of Booksellers and Bibliophile's Manual, 1899. Edited by James Clegg. (Rochdale: Aldine Press.) 6s. This unique compilation should bring the book-buyer and the bookseller into touch all round the world, seeing that the editor has penetrated to the most remote districts, and Trinidad is put into communication with Tonquin or Rhodesia. An invaluable book of reference.

BOOKS RECEIVED.

A Glossary of Popular, Local, and Old-fashioned Names of Birds. By Chas. Louis Hett. (Simpkin.) 6d.

Insects: Their Structure and Life. By Geo. H. Carpenter. (Dent.) 4s. 6d. net.

The Cambridge Natural History.—Insects. Part II. By David Sharp, M.A. (Macmillan.) Illustrated. 17s. net.

The Soluble Ferments and Fermentation. By J. Reynolds Green, F.R.S. (Cambridge University Press.) 12s.

Physics: Experimental and Theoretical. By R. H. Jude, M.A., D.SC. (Chapman & Hall.) 12s. 6d. net.

Curiosities of Light and Sight. By Shelford Bidwell, F.R.S. (Sonnenschein.) Illustrated. 2s. 6d.

Darwinism and Lamarckism Old and New. By Frederick Wollaston Hutton, F.R.S. (Duckworth.) 3s. 6d.

Rambles with Nature Students. By Mrs. Brightwen, F.E.S. (Religious Tract Society.) Illustrated.

The Modern Chess Primer. By Rev. E. E. Cunnington, M.A. (Routledge.) 2s.

Anatomical Diagrams for Art Students. By James M. Dunlop. (G. Bell & Sons.) 6s. net.

Report of Proceedings of the Museums Association. Edited by Herbert Bolton. (Dulau.)

Impressions of America. By T. C. Porter. (Pearson.) 10s. 6d.

Bacteria: Especially as related to Economy, Industrial Processes, and Health. By Geo. Newman. (Murray.) Illustrated. 6s.

The Commonwealth of the Body. By G. A. Hawkins-Ambler. (Scientific Press, Limited.) 1s. 6d.

Chats about the Microscope. By Henry C. Shelley. (Scientific Press, Limited.) 2s.

Kinetic Theory of Gases. By S. H. Burbury, F.R.S. (Cambridge University Press.) 8s.

The Indian Eclipse, 1898. Edited by E. Walter Maunder, F.R.A.S. (British Astronomical Association.) 5s.

The Principles of Mechanics. By Herbert Robson. (The Scientific Press.) 2s. 6d.

The Studio for July. 1s.

Wild Life in Hampshire Highlands. By George A. B. Dewar. (J. M. Dent & Co.) Illustrated. 7s. 6d. net.

The Birds of Breconshire. By E. Cambridge Phillips. (Brecon: Edwin Davies.) 7s. 6d.

TWO MONTHS ON THE GUADALQUIVER.

By HARRY F. WITHERBY, F.Z.S., M.B.O.U.

III.—REEDS AND RUSHES.

OUR second encampment in the *marismas* was surrounded by somewhat different country from that described in KNOWLEDGE, for March, 1899. Instead of scanty verdure, dry mud and shallow *lucias*, we had stretches of marshy land covered with fairly luxuriant grass, and great lakes, shallow but deeper than *lucias*, and thickly overgrown with rushes. This country, separated from the other only by the river, was inhabited by quite a different set of birds—a fact made more apparent when we re-visited the place later on after the birds had commenced to breed.

Instead of the larks and stone curlews of the dry plains, and the flamingoes and migrant waders of the *lucias*, on the borders of these rush-grown lakes were hundreds of stilts and redshanks,* while the lakes themselves were inhabited by many colonies of whiskered terns† and black terns.‡ Many other interesting birds had also located themselves here and there in reedy dykes and on patches of raised and dry ground.

The first of these lakes we visited extended over several square miles, and was completely overgrown with rushes; at a distance it looked like a great field of deep waving green, over which flitted and hovered in little companies thousands of graceful marsh terns, appearing sometimes dark and sometimes bright as they twisted and turned in the sunlight.

We hastened through the marshy ground, disturbing as we did so stilts and redshanks, which flew round us uttering loud alarm notes. Soon we were brushing aside the rushes, which were shoulder high, and wading up to our knees, and often to our waists, through the tepid water.

FIG. 1.—Floating Nest of Whiskered Tern.

We came upon a colony of terns; some rose from their nests and flew round us much agitated; others, their nests not yet completed, flitted past with mouths full of grass; while, again, some, their beaks at right angles, hovered over the water searching for prey, which they dashed down upon with a graceful plunge, captured, and had eaten almost before the water had run off their sharp wings and elegant body in a glittering spray.

* *Totanus calidris.* † *Hydrochelidon hybrida.* ‡ *H. nigra.*

XUM

Terns may be counted as among the most graceful of birds, and to watch the varied motions of a colony of whiskered or black terns is indeed a delight. Both these terns build, floating upon the water, nests of grass and rushes, but the black tern, judging from the many nests which we examined, although making a smaller nest, builds it much more compactly and raises it higher from the water than the whiskered tern. In the middle of May we found the nests in all stages. Many contained eggs, many were half finished, and several were merely foundations of a few pieces of rush placed across each other on the water.

Frogs abounded in this marsh, and many storks were wading often breast-high in the water in search of the savoury reptiles, or were flying high overhead clapping their beaks with a cŭp-cŭp-cŭp-cŭp, that resembled the sound of frogs croaking.

We waded on some two or three miles, passing many a colony of terns, and once more reached the shallow water, where noisy stilts and redshanks began again to assert themselves.

Redshanks are so abundant on our home marshes that it is not necessary for me to say anything about them. Stilts are much like redshanks in many of their habits. They are exceedingly noisy, especially when their nests are approached, and although we admired them much and watched them often we hated them on occasions when we were seeking better game and our presence was made known to everything within many yards by the "querep-querep" of the stilts overhead.

When feeding, stilts have also much the same action as redshanks, especially in the way in which they continually jerk their heads backwards and forwards. We found a great many of their nests, and noticed that those placed in swampy ground were built substantially, whereas those on dryer ground were much less so, while several found on quite dry ground were composed of nothing but a few pieces of grass placed in a "scoop." The birds became very much agitated when their nests were approached. They flew over us calling loudly, and repeatedly settled within a few yards of us, seeking to attract our attention by running about and jumping into the air as if they were dancing, then rapidly quivering their wings and with gaping beaks chattering softly and continually. While watching these birds we witnessed a curious little neighbours' quarrel. A long-legged stilt was making little rushes and dabs at a couple of redshanks, which looked so short and quaint compared with their tormentor, and all the time the three were uttering soft, but imprecatory noises (swear words we imagined) at each other.

The marsh was full of life. There were numerous tortoises, difficult to find amongst the weeds, and the whole place was infested with myriads of dragon flies, every rush being covered with its share of them. Once I gave one of our men, who seemed to have nothing to do but smoke the delicious *cigarillo*, a net, and showing him a dragon fly told him to go and catch as many as he could, as I wanted some for a friend. He went off delighted, and stayed away three hours and came back with one butterfly! Cigarettes and the sun were too much for him when he had once sat down out of sight.

On one occasion as we were watching some stilts and ducks a peregrine falcon suddenly appeared circling over their heads. The birds gradually became more and more frightened, until at last they rose from the water and took a short flight. Down came the falcon like a stone and knocked a duck on to the water, and there he left it floating keel uppermost. The ducks and stilts settled again, but the falcon still circled overhead until the now terrified birds rose again. This time he singled out a stilt, struck it in a flash, and left it like the duck floating on the water. Apparently he was only practising or having some sport, for he swept right away and left his victims limp and dead. But a dead body is not left for long in this country where hungry kites and birds of prey abound. One afternoon we shot and lost a duck and a slender-billed gull;* the next morning we visited the spot again, and on the edge of the marsh were two little heaps of feathers—one brown, the other a delicate pink—all that was left of the duck and the beautiful gull.

On the dry ground some distance from the marsh, or perhaps raised above it, many interesting birds were nesting, and all betrayed their anxiety as we approached. This they did in different ways, the pratincoles† with their strong swallow-like flight whirled round our heads and made as much noise and fuss as the stilts. They often settled very near us, but instead of dancing like the stilts they crouched, and spreading their long wings to the full

FIG. 2.—Stilt's Nest strongly built in Wet Ground.

extent rested them upon the ground. When they wish to rise from this position and fly they invariably close their wings, possibly because their legs are too short to raise the wings sufficiently, but they run fast with their wings closed. The eggs of this bird, two or three in number, are laid side by side in a little scoop in the dry mud. They are handsomely marked and mottled, but as their shape and colour are similar to a stone or a piece of mud at a short distance they are not easily discovered. There were other birds nesting in this dry mud near the water. Black and white avocets laid their four brown eggs in a hollow in the mud, usually adorned by a feather or two—often a bright pink one from a flamingo. In one spot we could stand still and touch five separate nests with a gun, and our horses sometimes trod on the eggs, so plentiful were they. Avocets do not annoy one like stilts and pratincoles; when their eggs are approached they fly round complaining for a few minutes, and then go away to stand and await developments at a distance; and so do the lesser terns‡ and Kentish plovers, the eggs of which we also found on this mud.

Besides many patches of tall reeds here and there in the marsh, there were several long dykes very thickly grown with reeds as high as small trees. These dykes resounded with the hoarse and incessant croaking of great reed warblers —small brown birds with loud harsh voices. As mentioned

* *Larus gelastes.* † *Glareola pratincola.* ‡ *Sterna minuta.*

in my first article these birds are difficult to see. Although bold enough when in cover—for they will cackle into one's ear at a yard's distance—they leave their retreats only to flit out and in again, and it is impossible to do more than catch a passing glimpse of them when amongst the waving reeds. We managed to beat some of them out and so get specimens, and we also found their beautiful nests, made of the flower of the reed and woven round four or five stems. Fastened in this way on the reeds they sway with every gust of wind, but the cup of the nest is so deep that the eggs are safe from falling out.

Whilst exploring one of these dykes in search of the great reed warbler, we saw a little bittern,* a black and creamy-white bird rather larger than a waterhen, run into a thick mass of reeds. We surrounded the spot, and eventually managed to drive the bird from its hiding place, but it ran past us like a rat and was up the bank of the dyke before we could move. We rushed to the top just in time to see it flying across to a reedy swamp, and thither we quietly followed it. Just as we reached the reeds another little bittern flew out. We shot at it but only succeeded in wounding it. The bird flew a short distance and then perched on a reed, gripping it firmly with one foot above the other. As we approached, the bittern pointed its bill straight up into the air, and stretched up its neck and body until it was long and attenuated and resembled a reed. This attitude is commonly employed by the bitterns for purposes of concealment when hard pressed. A brown-coloured bittern is exceedingly difficult to find in a reed bed when in this position, and so is a little bittern where the reeds are thick and the light broken up, but in the present case the pied plumage of the bird was very conspicuous in the more or less open place which it had chosen. The bird, however, seemed to consider itself quite invisible, for it remained stiff and motionless although we went within a few yards of it. By wading quietly through this reed bed we put up several more of these birds, and we had also the good fortune to find one of their nests made of dry pieces of reed, and carefully concealed. The nest contained five eggs of the purest dull white.

As mentioned in my first article, a small portion of the *marismas* is dotted over with pines and cork oaks, and overgrown with a very dense and tall undergrowth, composed of tamarisk, gorse, cistus and other shrubs, sometimes growing almost to the size of trees. This part of the *marismas* is near the sea, from which it is protected by miles of sand dunes. These are increasing so rapidly in height and breadth that many trees, and even whole woods, have been covered and eventually stifled to death by the shifting sand. In riding across these sand hills one actually passes over the tops of many a tall dead tree hidden under the sand, or guides one's horse amongst the topmost branches of some big pine, which is still living and fighting the irresistible sand that will eventually smother it. The sight of a grove of these trees buried up to their "necks" in sand and yet still living, is not to be forgotten.

We approached this country from the river, and as our boat neared the shore we noticed that the mud of the river bank was thickly studded with what looked like small stones, but no sooner had our boat grounded than all these "stones" disappeared as if by magic. We landed and found that the mud was bored in every direction with holes, and on going a little distance off and remaining quiet, the "stones" appeared again in thousands, and we soon discovered that they were really small brown crabs. The crabs seldom stray far from their holes, so that it was by no means easy to catch any of them. If surprised suddenly, and not being able to reach his own home, a crab would dart into a neighbour's hole, but only to be chased out by the owner, and thus he could be captured before going to ground again. Some curlew* and whimbrel† were running about on the edge of the river at a little distance away from us, and with our glasses we could see that every now and again one of the birds would make a rush, and catching a crab by a leg would drag it from its retreat. The bird would then walk off with its captive to the hard ground, and after breaking the crab's shell against the stones, as a thrush does a snail, make short work of its soft inside.

Of the many interesting birds such as eagles and kites to be found in the wooded part of this country I hope to write in a subsequent article. Occasionally amongst the tamarisks there is a small lake often with an island, sometimes covered with reeds or rushes, sometimes with tamarisk. Many kinds of herons breed on these islands in colonies. Owing to the dry spring of 1898, water, and hence food for the birds, was scarce, and consequently they began to breed much later than usual. Up to the 7th of May, no herons, excepting the purple heron, were to be found at their breeding places. However, we had ample opportunities of watching these beautiful birds, which were always to be seen feeding in the marshes bordering on the wooded land. A most striking and beautiful sight is that of a flock of buff-backed herons,‡ looking a dazzling white in the sunlight, attending on a herd of black bulls or a group

Fig. 3.—Stilt's Nest slightly built on Dry Ground.

* *Ardetta minuta.*

* *Numenius arquata.* † *Numenius phoeopus.*

‡ *Ardea bubulcus.*

of horses. Some walking by the side of the cattle are constantly stretching out their beaks to the horses' head or jumping up to its belly, in order to snap off a fly or tick which they have spied; others perched on the backs of the beasts relieve them of many an enemy. All the while the cattle never flinch, but seem to know perfectly well

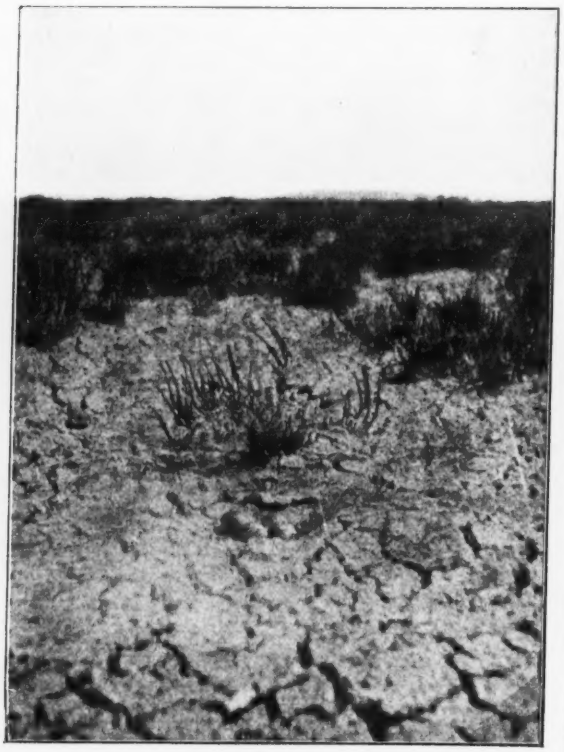


Fig. 4.—Avocet's Eggs in a Scoop in the Mud.

that the birds with their graceful movement and delicate peck are doing them a service.

Squacco herons,* with reddish-brown backs, were also in these marshes, as well as many flocks of that most beautiful of all the heron tribe—the little egret.† The entire plumage of this lovely bird is of a pure snowy white, its beak and legs are black, and its eyes yellow. Like all the herons it has long plumes on the head and breast, and growing from the middle of its back, and drooping over its wings, are those filamentous wavy feathers so exquisitely beautiful on the bird—so artificial and unsightly on a woman's bonnet.

* *Ardea ralloides.* † *Ardea garzetta.*

SECRETS OF THE EARTH'S CRUST.

By Grenville A. J. Cole, m.r.i.a., f.g.s., *Professor of Geology in the Royal College of Science for Ireland.*

IV.—A CALDRON OF THE ROCKS.

THE phenomena of volcanoes, so full of mystery, so fraught with perilous excitement to those who dwell upon their flanks, have been disguised in a haze of erroneous statements, and in much poetic imagery, born of astonishment and fear. To this day, such expressions as "the smouldering of subterranean fires," or "vast clouds of incandescent gas," are by no means confined to the daily press, or the pages of sensational magazines. Sir William Hamilton,* the well-known Envoy of His Majesty at the Court of Naples, may be said to have set the example, so far as English observers are concerned, in systematic observation, day by day, of what actually goes on in a volcano. His views on the structure of volcanic cones anticipated those of Scrope,† and his researches, in a large degree, preceded those of his Italian contemporary, Spallanzani. In later years, our ideas have been kept, as it were, from wandering, by the successive editions of Scrope's memorable works, and by the series of papers from the pen of his successor, Prof. J. W. Judd.‡ Prof. Judd, in his book on "Volcanoes,"§ has summarised a long series of observations; while Sir A. Geikie‖ has recently called attention to the debt we owe to the great French geologists in the early years of the present century. The latter author has also added, in his history of volcanic action in our islands, to the large debt we owe to his own writings.

If the elucidation of the visible phenomena of volcanoes still remains a subject for discussion, far greater difficulties are sure to be experienced when we try to realise what is going on beneath the surface. What happens in the great underlying lava-basin, in this unseen caldron of the rocks? What evidence have we as to its nature? How can we hope to make any actual observations?

In the venerable, but highly erroneous diagrams that may still be found in atlases of physical geography, a section of the earth's crust may be seen, in which the whole stratified series is piled up, like a sloping row of books, and resting at one end upon a primitive mass of granite. The high antiquity of granite, and its eminently fundamental character, are conceptions which date back to the last century, and which were not then to be lightly called in question.

Yet, when James Hutton,¶ in 1785, made his famous discovery in Glen Tilt, and showed that granite sent off veins into the surrounding rocks, its supposed fundamental character was successfully assailed. The theory of the deposition of all crystalline rocks from the waters of a primitive ocean was at one time widely accepted, and was held by some Italian geologists down to very recent years. Yet, from Hutton onwards, observation after observation showed that such rocks were intrusive in others at their margins, and were at times, therefore, of later date than Mesozoic or Cainozoic rocks.** If, as was thus generally proved, granites and their kindred were at one time in a state of fusion, with what type of igneous phenomena were their features most nearly allied?

The modern volcano does not erupt granite, or diorite, or gabbro, or any material in a highly crystalline condition. The fused and viscid lava, when it consolidates, may even form a glass, imperfect, it is true, but certainly glassy to the eye. The surface of highly siliceous lava-flows, like the Rocche Rosse of Lipari, resembles the broken refuse of a bottle-factory; while the smoother and

* "Observations on Mount Vesuvius, Mount Etna, and other Volcanoes," 1772; Second Edition, 1773; also the superbly illustrated folio on the Campi Phlegræi, 1799.

† "Considerations on Volcanoes," 1825.

‡ "Contributions to the Study of Volcanoes," *Geol. Mag.*, 1875.

§ *International Scientific Series*, 1881.

‖ "Ancient Volcanoes of Great Britain" (1897), Vol. I., preface.

¶ *See* Lyell, "Principles of Geology," Vol. I. (1830), p. 62; Hutton, "Theory of the Earth," Vol. III., now first published in 1899.

** *See*, for instance, Knowledge, Vol. XXI., p. 124.

basaltic rock of Kilauea, in Hawaii, has also a coating of some two inches of black glass. Occasionally, as in the wonderful valley near Hlinik, in north-west Hungary, or at Obsidian Cliff, Yellowstone Park, huge rock-masses may be seen, consisting throughout of natural glass. In most cases, however, the inner portion of the lava-flow is dull and partly crystalline, while the centre may reveal no glass, even when seen in section under the microscope. A dense mass of felted crystals has arisen; the fused rock has passed through its glassy stage while at a high temperature; the heat has been maintained sufficiently long for the molecules of the silicates to creep together; and a stony lava is the result. The mass has *devitrified*, as glass-workers say; and all the stages, as Sir James Hall showed long ago, may be successfully imitated by experiment.

In the dykes, which are exposed where portions of a volcanic cone have been broken down, matters may have proceeded farther. These wall-like masses of rock represent lava that has cooled in fissures; and they have probably been exposed at no point to the open air. A glassy film may appear on their edges, where the lava was first chilled by contact with the surrounding rock; and their thin veins or offshoots may easily be vitreous throughout. But the central portions of a dyke will in general be more crystalline than any portion of a lava-flow of similar composition. They will, in fact, approximate to the structure of granite and its allies.

The microscope, indeed, shows that the approximation is a very good one. The minerals that have developed are, with very few exceptions, similar to those that occur in coarsely crystalline rocks of the same chemical composition. Their mode of grouping in the rocks of the dykes is again and again paralleled in sections cut from coarsely crystalline materials. The structures seen in lavas are, then, to be found in the outer portions of dykes; those of granite and its allies occur in the central portions. The scale may be more minute, and that is all.

Certain types of mineral-aggregation may appear in the intermediate regions of the dykes, or throughout dykes of only moderate thickness, which at first sight seem peculiar to these masses. These structures are found, however, to be intermediate in character between those of ordinary lavas and the coarser type of igneous rock; and they are repeated, moreover, in the heart of massive lava-flows. One is forced to correlate these modes of aggregation of the minerals, and the presence or absence of a glassy groundmass, with the conditions of temperature and pressure under which the rock consolidated.

It may, then, be fairly conceded that very slow cooling underground, under considerable pressure, has produced the crystalline characters of granite. The water that escapes so freely as steam from lava-flows at the surface may be imprisoned in deep-seated masses, and may have its effect on the order of crystallisation of the constituents, and even on the nature of the minerals themselves. Yet, when we examine the offshoots of a granite or a gabbro—*i.e.*, the dykes which have arisen along the margin of these masses—we find that the links are complete with the dyke-rocks of our present-day volcanoes. We must allow for the weathering of some constituents, and for the superior freshness of rocks formed in our late Cainozoic epochs; but, with this proviso, the comparison can be carried out down to minute structural details.

Lavas, again, whether they cool in dykes or flows, frequently contain what are called "porphyritic" crystals. These are larger than those in the general groundmass, and give the rock the character of the "porphyry" of the Greeks and Romans. They float, as it were, in the ground, and are frequently broken and eaten into, showing that they have not developed under the conditions that prevailed during the flow of the molten mass. They must have separated out in quieter times, and doubtless under greater pressure. May they not be the relics of a stage of consolidation which set in far below the surface? This stage was interrupted by renewed fluidity being given to the mass, through reheating, or by access of water,* or, perhaps, by mere relief from pressure as the mass rose towards the surface; and the crystals already formed were carried upward in the lava. Many of them were remelted in the process; many remained to tell the tale. The latter form the "crystals of the first consolidation," the importance of which has been so fully urged by M. Lévy, in his critical studies of the structure of igneous rocks.

Here we are getting some glimpse of the features of our underlying caldron of the rocks. We may well ask, what would have happened if the slow crystallisation had gone on, if no subsequent movement had occurred? Surely a completely crystalline mass would have arisen, coarser in all its features than the materials examined by us at the surface. Granite and the lava known as rhyolite have precisely the same chemical composition; diorite is similarly related to the lava andesite, gabbro to the well-known lava, basalt. Where, then, we have rhyolite, andesite, or basalt at the surface, should not granite, diorite, or gabbro, be respectively forming underground?

The transition seems easy to us when put in this form; but the argument at one time was beset with difficulties. The peculiar Teutonic aptitude for classification rather than comprehension obscured the issue with a flood of papers which were intended to prove the essential dissimilarity of ancient and modern igneous rocks. Granites and gabbros and such like, our German friends urged, are all of ancient date. Abandoning the theory that such rocks were truly primitive, an arbitrary line was drawn at the close of Mesozoic times, and every igneous material now forming was supposed to differ in some way from those produced in Cretaceous or earlier days. It was vain for such workers as the late Mr. S. Allport,† who ranks as one of our foremost pioneers in microscopic work, to urge that decomposition during long ages was responsible for such mineral and structural differences as could be observed; or for Mr. F. Rutley‡ and others to show that slow secondary devitrification would account for the absence of true glasses among ancient volcanic lavas. The German classifications had been based upon a theory sustained by hand-specimens and microscopic slides. The appeal from an orderly collection to the rude disorder of external Nature was repugnant to the careful mind; and even the great French authors were drawn into the net, and were enfolded in the meshes of the text-books.

Prof. Judd, in his papers on the "Secondary Rocks of Scotland," and on the "Volcano of Schemnitz,"§ laboured hard to prove that highly crystalline igneous masses arise naturally in connexion with volcanoes. We cannot usually trace the actual passage from one type of product to the other, since a long lapse of time is necessary before the caldron itself can be laid bare. In the Western Isles of Scotland, however, the coarse gabbros and well-developed granites were proved to be of Cainozoic age; and the same fact has been admitted with regard to other masses, where denudation has been sufficiently severe to

* *See* Judd, "The Natural History of Lavas," *Geol. Mag.*, 1888, p. 9.

† *Geol. Mag.*, April, 1870; and *Quart. Journ. Geol. Soc.*, Vol. XXX. (1874), p. 565.

‡ "Devitrified Rocks from Beddgelert and Snowdon," *Quart. Journ. Geol. Soc.*, 1881, p. 407.

§ *Quart. Journ. Geol. Soc.*, 1874 and 1876.

reach down into the volcanic core. The elaborate proofs, moreover, afforded by the mine-shafts of Nevada,* destroyed any belief in America as to the structural distinction of Cainozoic and older igneous rocks. Highly crystalline rocks, regarded previously as ancient, were found to be in continuity, in sections three thousand feet in depth, with the lavas that had been described as Cainozoic.

Finally, the authors of rock-classifications based on geological age retreated step by step, as Von Buch and the Wernerians had done before them; and we may now seek to read, without opposition, the history of a modern volcanic caldron in one of our old deep-seated masses.

The dykes and veins sent off at the margins of such masses seem natural enough; the rocks have cracked and yielded round about the igneous invader. But the actual position of this invader raises many difficult problems; and the huge mass of the caldron or reservoir is often astounding, compared with anything that we see in volcanic action at the surface. When, however, we consider the extent of what Prof. Judd has called volcanic provinces—areas over which similar volcanic rocks are simultaneously erupted—we may well see that one caldron may have to serve vents scattered over thousands of square miles. Many caldrons, moreover, may remain unconnected with the surface, and may fulfil their period of activity in merely attacking their surroundings.

Whether connected with a true vent or not, how does the reservoir arise? Its frequent nearness to the surface, considering the great thickness of the solid crust, makes it improbable that it remained as a liquid mass from the first consolidation of the globe. Evidence of the intrusion of the liquid, moreover, is again and again forthcoming; yet how was space found for it in the tightly packed material of the crust?

A tempting theory, current from Hutton's time down to about 1860, was based on the assumption that sedimentary or other rocks could be metamorphosed into a highly crystalline state *in situ*, while still retaining at their margins traces of their former structure.† What may thus be called progressive metamorphism provided an easy escape from the difficulties of an intrusive theory. The granite or gabbro merely represented the mass that was there before crystallisation set in. A partial melting might then account for the offshoots at its margins. Case after case, however, broke down upon investigation; and the modern tendency has been to refer one metamorphic rock after another to an igneous origin, rather than to allow any igneous rock a metamorphic origin. It can hardly be denied that sedimentary materials have from time to time become melted up since their first appearance on the globe; but this implies a complete change in their character, and the cycle of events may be very rarely traceable.

Seeing that igneous rocks can have little inherent power to force open cavities for themselves, we are apt to fall back on earth-movements to explain the position of our caldrons; and we may reasonably suppose that rocks which were once in contact may become bent apart during the severities of folding. Such separations take place in the experiments that have been devised to imitate mountain-structures; and, in nature, any molten material would at once be forced into the hollow as it formed. External pressure on this material, and the expansion of the water contained in it, would account for its intrusion.

It is not surprising, then, that what have been called "laccolites"* occur, where one series of strata has been pushed up in a dome, like a great bubble, over the surface of the underlying beds, the cavity being filled, step by step, by intrusive igneous matter. It is generally believed that the igneous rock, acting under earth-pressures, is itself the cause of the local uplift and of the formation of the dome. Here we have our caldron formed progressively. Any fissures that open above it may lead to volcanic action at the surface.

Given the caldron, however, can we conceive it to have no action, beyond mere metamorphism, on its surroundings? Almost every crystalline mass, when worked over in the field, shows signs of local variation. The subject has been recently discussed, in its broad aspects, by Sir A. Geikie,† and absorbs the attention of petrologists in every land. The same rock-mass—our consolidated caldron—may be extremely rich in silica in one part, and may consequently have given rise to granite or quartz-diorite; while in another part it may be poor in silica and rich in magnesia and iron. Extreme types of igneous material may thus be found in association, and pass by degrees into one another. Where movement has taken place, two kinds of material may have become streaked out together, so that a banded gneissic rock results, truly igneous in origin, but implying differences in constitution in the original magma of the caldron.

How have these differences been brought about? Elaborate theories have been devised, whereby it is shown that a mixed mass of silicates will naturally tend to divide itself into magmas of varying composition. On the other hand, we have striking examples of igneous masses, extending over thirty or fifty linear miles, in which very little variation can be traced. It must be admitted, however, that in such cases the differentiated portions may lie far away below our feet, or may have been already removed by denudation.

When we view, in a fortunate locality, the edge of a great igneous mass against a series of stratified rocks, we must be struck with the extent to which blocks of the latter are picked off and lie scattered through the invader. But these disappear as we retreat from the contact-zone, and sometimes do so with surprising rapidity. Can it be that the caldron has attacked its surroundings for a distance of fifty or sixty feet, but was powerless to effect further destruction?

If we examine the included blocks themselves, we find them altered in various degrees; many of the smaller ones are penetrated throughout by the igneous material, and have become completely crystalline. Shales and slates have thus come to assume the aspect of basic igneous rocks. By intermixture of the materials, and by partial absorption of the sediment in the igneous invader, new rocks have been actually formed. If these fragments have happily survived the extremes of change, how many more may have been completely dissolved in the great caldron? Is it not probable that vast masses of sediment, penetrated by the insidious magma along all their cracks and crevices, have been cut up into detached portions, and have entirely melted and disappeared?

But such absorption must have influenced the chemical composition of the invader. In many cases, the bulk of the latter is so great that little change has been effected in it. In other cases noticeable differences have arisen. Can we not explain many supposed cases of "magmatic differentiation" by such local phenomena of absorption?

* Hague and Iddings, *Bull. U. S. Geol. Survey*, No. 17 (1885).

† *Cf.* Portlock, "Geol. Report on Londonderry, &c.," 1843, p. 507.

* G. K. Gilbert, "Geology of the Henry Mountains," 1877, p. 51, &c.; also Whitman Cross, "Laccolitic Mountain Groups," *14th Ann. Rep. U.S. Geol. Survey*, p. 236.

† "Ancient Volcanoes of Great Britain," Vol. I., p. 90, etc.

The phenomena of mixture exhibited when one igneous rock penetrates another have led Prof. Sollas* to question the potency of differentiation; and his general conclusions may be supported in many other areas than the one selected by him. Probably the French geologists are at present most active in showing the extent to which an igneous caldron may react on the surrounding rocks. M. Barrois,† to take one excellent example, finds that the granite of Ménez-Bélair, in Brittany, has eaten its way along the strike of a series of tilted shales and sandstones, but has penetrated the former to a far greater distance than the latter. Bands of quartzite remain as ridges in the granite area, and represent the undissolved layers of the sandstone. This example of selective absorption should go far to explain the position of many intrusive igneous masses. Our caldrons do not merely occupy hollows prepared for them by earth-movement; they extend at their surfaces by absorption, and the igneous mass becomes increased in bulk, and at the same time modified in composition. Provided that the absorption is on an extensive scale, materials may be imported of such differing character that a sort of average composition may be reached. In such cases a uniform type of igneous rock may be arrived at, not far different from those highly siliceous masses that fill most of our solidified caldrons at the present day. Persistent absorption and melting imply a return of the sedimentary materials towards the igneous rocks from which they came. The cycle is, indeed, that pictured by Hutton and the old geologists, though the process is shortened by the direct refusion of the sediments, instead of their progressive metamorphism.

It may be observed, in conclusion, that M. Stanislas Meunier,‡ bold in his generation, is prepared to derive all the water required for volcanic action from the absorption of water-logged superficial rocks by the igneous layers underneath them. Without making such large demands, we may yet see in our familiar igneous rocks the result of a series of mixtures, refusions, and interpenetrations; while down below, in still more mysterious caldrons, lie the purer magmas which rarely reach us unalloyed.

NOTES ON COMETS AND METEORS.

By W. F. DENNING, F.R.A.S.

SWIFT'S COMET (1899a).—This object is now exceedingly faint, and in the early part of August will be only one-fiftieth as bright as it was at the time of its discovery early in March. But its apparent brightness varies suddenly and unaccountably. The following estimates by Holetschek, of Vienna, exhibits the remarkable changes it underwent in June last.

	Mag. of Nucleus.	Mag. of Comet.
June 1	9·5	5·5
„ 2	9·5	5·7
„ 3	—	6·0
„ 4	7·5	5·3
„ 5	7·0	4 5
„ 6	8·0	4·7
„ 8	9·5	6 (?)
„ 9	9 0	5·7

TEMPEL'S COMET (1873 II.).—This comet is now practically invisible to observers in this country owing to its low position in the sky. For the benefit of southern observers we give its place on one moonless night in each of the next four months.

Date.	R.A. h. m. s.	Dec.	Distance in Millions of Miles.	Brightness.
Aug. 4 ...	20 57 26	− 26° 14′ 6″	35	3·59
Sept. 5 ...	21 38 29	− 35° 59′ 37″	47	1·89
Oct. 3 ...	22 19 17	− 34° 7′ 1″	67	0·80
Nov. 4 ...	23 8 29	− 26° 31′ 7″	100	0·29

HOLMES'S COMET should be favourably visible during the first half of August, moving slowly to N.E., in the region between the constellations of Aries and Perseus. The following are its positions on three nights.

Date.	R.A. h. m. s.	Dec.
Aug. 4 ...	2 36 50	+ 33° 4′
„ 8 ...	2 41 43	+ 34° 9′
„ 12 ...	2 46 24	+ 35° 14′

CODDINGTON'S COMET.—Mr. C. F. Merfield (*Ast. Nach.*, 3577) thinks that this object may just possibly continue to be visible in August. Its position on August 3rd is R.A. 5h. 11m. 34s., Dec. + 0° 47′, and on August 31st, R.A. 5h. 21m. 1s., Dec. + 1° 19′. Its distance from the earth on August 3rd and 31st is four hundred and twenty-eight and four hundred and sixteen millions of miles respectively. The comet will appear to be very nearly stationary during the month of September.

BARNARD'S COMET (1892 V.).—A sweeping ephemeris has been computed by Coniel, but the re-detection of this faint object must be undertaken by an observer having the use of a large instrument such as that at the Lick or Yerkes observatory.

KLINKERFUES'S COMET (1854 IV.).—The definitive orbit of this comet has recently been determined by Drs. Buschbaum and Steiner. About two hundred observations were obtained between September 12th and November 14th, 1854. The computers find that the comet moved in an elliptical orbit with a period of 1088·78 years, with a possible error of seventy years.

Aerolite of March 12th.—The *Bulletin de La Société Astronomique de France* (June, 1899) contains some interesting accounts both of the flight of this luminous bolide and of the descent of the solid material comprising it. The object is described by observers in Sweden, and others in Livonia and the N.W. parts of Russia. At Borgo, in Finland, there took place something like an earthquake, and it was there that the aerolite fell on the frozen sea surface, producing a hole nine metres in diameter. The stone must have been a huge one, probably weighing one thousand kilogrammes. At several different places in Sweden the colour of the fireball as it sped down the sky was described as similar to that of an electric lamp, and its light surpassed that of the full moon. Prof. Herschel has examined the various accounts, and concludes that the radiant point was probably in about 105°—20°. The meteor nearly crossed the zenith at Dorpat and Wesenberg, and after passing over the Gulf of Finland, fell to earth at or near Borgo, on the south coast of Finland. It probably began over a point about fifty miles east of Walk, in Livonia, and was eighty miles high when over Wesenberg, its motion above the earth's surface being directly towards N. by W. A Reuter's telegram, dated Helsinfors, May 26th, says: "The collected pieces of the aerolite which fell at Burgo have been sent here and placed in the Geological Museum. The largest piece is said to weigh two hundred and six Russian pounds, while all the parts together weigh eight hundred and fifty pounds."

Meteoric Fireball of June 1st.—A very brilliant meteor was observed at 9h. 20m. p.m. by observers at Kettering, Dewsbury, Manuden, near Bishop Stortford, and other places. At Dewsbury the lustre of the object was estimated as four times as bright as Jupiter. The various observations are not, however, sufficiently full to admit of the derivation of very precise results, but it appears probable that the radiant point was approximately in or near the zenith (at about 208° + 51°), and that the meteor terminated its luminous flight at a height of thirty miles above King's Lynn, in Norfolk. There is a well-defined radiant near θ Boötis (No. 164 of my General Catalogue in *Memoirs of the R.A.S.*, Vol. LIII., p. 263) which conforms very nearly in position and date with this fireball radiant.

THE GREAT PERSEID SHOWER.—A favourable opportunity will be presented this year for recording the progress of this shower during the first half of August, as there will be very little moonlight. It seems desirable to direct special attention

* "The Relation of the Granite to the Gabbro of Barnavave," *Trans. R. I. Acad.*, Vol. XXX (1894), pp. 502—510.

† "Le Bassin du Ménez-Bélair," *Annales de la Soc. Géol. du Nord*, Tome XXII. (1894), pp. 223, 231, 342, etc.

‡ "La Géologie Expérimentale" (1899), p. 266.

XUM

to the following points connected with the display, viz. :—The date and hour of maximum ; the horary rate of the Perseids, and the exact situation of the radiant point on each night of observation.

In 1898 the maximum occurred on August 11th, and it is certain that for some time in the future the shower will be at its best on a similar date and not on August 10th, as hitherto. The fact that 1900 will not be leap year favours this conclusion.

The position of the radiant will be as follows :—

Date.	α	δ	Date.	α	δ
Aug. 3 ...	36·7°	+ 55·2°	Aug. 12 ...	47·5°	+ 57·5°
„ 6 ...	40·2°	+ 56·0°	„ 15 ...	51·3°	+ 58·2°
„ 9 ...	43·8°	+ 56·8°	„ 18 ...	55·2°	+ 58·9°

The accuracy of these positions should be tested by further observations.

Microscopy.

By John H. Cooke, F.L.S., F.G.S.

According to Nocht, the success of the nucleus stain of Romanowsky, a mixture of eosin and methylene blue, depends upon the presence of certain impurities in the methylene blue. To obtain the best results the use of polychromic methylene blue is suggested, as the essentials for the formation of the nuclear stain are more frequently met with in this than in any other. Before using, its alkaline reaction should be neutralized with acetic acid, and the solution should then be mixed with ordinary methylene blue until it is clear and blue. Finally dilute the fluid with a one per cent. aqueous solution until a reddish tinge is apparent near the edges. Macerate the preparations in this for some time, and if too much stain is taken up decolourize with dilute acetic acid.

The causes of the colouring of leaves in autumn has formed the subject of a series of investigations by Mr. E. Overton. The leaves that turn red he classifies under two heads, those which remain throughout the winter, and those that fall soon after their change of colour. Microscopic examination show that in both cases the palisade cells, and the cells that line the air-chambers of the leaf, are charged with a red cell sap of the nature of glucosides. The cultivation of *Hydrocharis morsus-ranæ*, of *Utricularia*, and many other land plants, in a weak solution of glucose, confirmed his deductions. In each case the leaves assumed a rich reddish-brown tint.

For general botanical work the most useful killing and fixing agents are solutions containing chromic acid. In the last issue of the *Journal of Applied Microscopy*, Prof. C. J. Chamberlain, of Chicago University, discusses the results of his experiments with the chromic acid groups, in the course of which he gives some valuable notes on the strengths of the solutions used. For spirogyra, fern prothallia, and similar objects, he suggests a solution made up of chromic acid, two grammes ; acetic acid, one cubic centimetre ; and water, ninety-seven cubic centimetres. If plasmolysis takes place, weaken the chromic, or strengthen the acetic, since the chromic has a tendency to produce contraction, and the acetic to cause swelling. Too large a proportion of acetic acid, however, may cause distortion, and hence it would be better to weaken the chromic acid.

Referring to the time that should be allowed for the fixing of tissues in chromic solutions, Prof. Chamberlain has found that twenty-four hours should be the minimum even for the most delicate objects. It is well known that zoologists allow fixing agents like Müller's fluid and Erlicke's fluid to act for weeks before the material is passed on to the next stage, and it is therefore questionable whether the time which is usually allowed by microscopists when using chromic acid solutions is not much too short. Sixteen to twenty-four hours is the time usually allowed ; but Prof. Chamberlain's experiments show that the material is better able to withstand subsequent processes if it has been kept in the fixing solutions for two or three days. More rapid penetration, and consequently more immediate killing, can be secured if the reagent is kept at a temperature of from thirty degrees to forty degrees Centigrade.

Wickersheim's Preserving Fluid is a valuable reagent, but it is not commonly used owing to the poor preparations that have been put on the market. Animal and vegetable bodies impregnated with it retain their form, colour, and flexibility in the most perfect manner. The objects to be preserved are placed in the fluid, and left in it for from six to twelve days, after which they are dried in the air. The ligaments remain soft and movable, and the animals or plants remain fit for anatomical dissection and study for long periods. The formula for the fluid is as follows:—Dissolve one hundred grammes alum, twenty-five grammes common salt, twelve grammes saltpetre, sixty grammes potash, ten grammes arsenious acid, in three thousand grammes boiling water. Filter the solution, and when cold add ten litres of the liquid to four litres of glycerine and one litre of methyl alcohol.

For the preservation of arachnids and myriapods the following mixture is recommended :—Glycerine and Wickersheim's fluid one and a-half ounces each, and distilled water three ounces, the whole to be shaken and thoroughly mixed and added to thirty ounces of ninety-five per cent. alcohol. He considers that alcohol that has been previously used for preserving mites and spiders is preferable to pure alcohol, as the former already contains some of the fats dissolved out of the specimens. This liquid preserves the colouring of the specimens, and keeps them flexible.

For five months Dr. Marsson concentrated his attention on the study of the variations of the animal and plant life of the plankton of the Leipsig ponds, one result of which has been the discovery of many new and interesting—though anomalous—facts. Two ponds, separated only by a road, never contained the same forms. *Volvox aureus* was found in abundance in the pond on the south side, but not a single specimen could be found in that on the north. *Synura uvella* was found in the one, in September, in great quantities, and none at all in the other. Both ponds afforded similar conditions of depth, character of soil, light, and plant growth, and swans and other water birds frequented both. On the 20th May, *Tintinidium fluviatile* made its first appearance in a pond, and on the 26th it formed the largest constituent of the plankton, after which it disappeared and did not return. In April, *Codanella lacustris* appeared in this same pond, then it disappeared entirely, and was first found in other ponds in August.

To many microscopists the terms "one quarter inch," or "one half inch," as applied to their objectives, convey the idea that, when in focus, the object is at a distance of a quarter inch, or a half inch, from the front lens. They confound the equivalent focal length of the objective with the working distance. As a matter of fact, the latter is always considerably less than the former. The determination of the working distance of an objective is a point of considerable importance, and therefore all microscopists should make themselves familiar with the method of calculating it. The following simple device will be found useful for estimating the working distance of objectives that are not higher than one-twelfth inch. Make a long thin wooden wedge, ten centimetres in length along the base, and twenty millimetres in perpendicular height. Focus a diatom on a glass slip without a glass cover, and then carefully push the wedge along the glass slip until it touches the objective. The thickness of the wedge at the point of contact will represent the working distance of the objective.

Prof. Leroy gives, in the *Journal of Applied Microscopy*, the results of his experience in the use of picro-carmine as a counter-stain for bacteria in tissues. As a rule this reagent is somewhat uncertain in its effects, and it is therefore suggested that, to obviate risk of failure, the tissues should be first treated with logwood picro-carmine, and finally stained by Gram's method of bacterial staining. As a counter-stain, alum carmine alone gives only a nuclear stain and leaves the cytoplasm practically untouched. Better results can be obtained by first staining in alum carmine or borax carmine, then carrying the section through the regular Gram process, and lastly leaving the section for half a minute in a solution of sodium sulp.-indigotate 0·1 gramme, and carbolic acid, five per cent. aq. sol. one hundred cubic centimetres, after which follow on with alcohol, creasote, and balsam. By this method the nuclei will stain red, the cell bodies apple green, and the bacteria purple (if gentian violet be used in the Gram's solution).

THE FACE OF THE SKY FOR AUGUST.

By A. FOWLER, F.R.A.S.

THE SUN.—On the **1st** the Sun rises at 4.25, and sets at 7.47; on the **31st** he rises at 5.12, and sets at 6.48. Spots are still occasionally to be seen.

THE MOON.—The Moon will be new on the **6th**, at 11.48 A.M.; will enter the first quarter on the **14th**, at 11.54 A.M.; will be full on the **21st**, at 4.45 A.M.; and enter the last quarter on the **27th**, at 11.57 P.M.

The brightest star occulted at a convenient time during the month is *f* Sagittarii, magnitude 5·1, on the **18th**; the disappearance takes place at 10.28 P.M., at an angle of 50° from the north point (44° from the vertex), and the reappearance at 11.34 P.M., at 267° from the north point (251° from the vertex). Other occultations are:—19 Piscium, magnitude 5·2, on the **23rd**, from 3.1 to 4.8 A.M.; τ^2 Arietis, magnitude 5·2, on the **27th**, from 12.5 to 1.5 A.M.; υ^1 Tauri, magnitude 4·6, on the **28th**, from 4.20 to 5.19 A.M.; η Geminorum on the **30th**, from 4.9 to 5.25 A.M.; ζ Geminorum on the **31st**, from 2.59 to 3.58 A.M.

THE PLANETS.—Mercury moves westwards towards the Sun until the **19th**, when he will be in inferior conjunction. He will afterwards be a morning star, and at the end of the month will come into a very favourable position, a few degrees west of Regulus. The greatest westerly elongation, of 18° 2′, will occur on the morning of September **5th**.

Venus is unfavourably situated for observation. She is approaching superior conjunction, and the apparent diameter is therefore small (9·8″ on the **15th**), and the disc nearly full.

Mars sets so soon after the Sun this month that he may be considered not observable. He is near β Virginis at the beginning of the month, and moves in a south-easterly direction.

Jupiter remains an evening star, low down in the south-west, soon after sunset. His apparent polar diameter at the middle of the month is 32·2″. The satellite phenomena are not very numerous during the short periods available for their observation. At 8.43 P.M., on the **3rd**, there will be egress of the shadow of the second satellite; on the **10th**, at 8.51 P.M., transit egress of the second satellite; and on the **24th**, at 7.56 P.M., an eclipse reappearance of the first satellite.

Saturn may be observed until nearly midnight during the early part of the month, low down in the south or south-west. He is between η and θ Ophiuchi, and traverses a westerly path until the **21st**, when he will be stationary, and during the rest of the month an easterly path. The rings are widely open, and their northern surfaces are presented to us. On the **3rd**, the apparent polar diameter of the planet is 16·4″, and the outer major and minor axes of the outer ring are respectively 40·9″ and 18·5″.

Uranus is also an evening star, but like Jupiter and Saturn can only be observed for a comparatively short time after sunset. He is in Scorpio, a little less than halfway from ν to 19 of that constellation. At the middle of the month the planet sets shortly before 11 P.M.; is stationary on the **12th**, and in eastern quadrature on the **27th**.

Neptune cannot be observed this month.

THE STARS.—About 10 o'clock at the beginning of the month, Perseus and Cassiopeia will be in the north-east; Pegasus, Andromeda, Aries, and Pisces towards the east; Aquarius and Capricornus in the south-east; Cygnus and Lyra nearly overhead; Aquila due south; Hercules and Ophiuchus towards the south-west; Corona and Boötis in the west; and Ursa Major in the north-west.

Favourable minima of Algol will occur on the **2nd**, at 11.31 P.M., and on the **25th**, at 10.1 P.M.

Chess Column.

By C. D. LOCOCK, B.A.

Communications for this column should be addressed to C. D. LOCOCK, KNOWLEDGE Office, 326, High Holborn, W.C., and should be posted by the 10th of each month.

Solutions of July Problems.

(By J. K. Macmeikan.)

No. 1.

1. Kt to B2, and mates next move.

No. 2.

1. R to B8, and mates next move.

CORRECT SOLUTIONS of both problems received from Alpha, E. Servante, G. A. Forde (Capt.), N. M. Munro, G. J. Newbegin, H. S. Brandreth, J. Baddeley, A. H. Doubleday, G. C. (Teddington), W. de P. Crousaz, H. Le Jeune, H. H. Thomas, K. W., W. d'A. Barnard, D. R. Fotheringham, K. R. B. Fry (Cheltenham College), T. Frampson. Of No. 1 only, from W. H. Jones, W. Grimshaw.

A. H. Doubleday.—Variations are quite unnecessary in two-movers.

W. Grimshaw.—After 1. P to B4ch, K × R; there is no mate.

Alfred Osborne.—Your solution of No. 2 (June) is correct, but arrived too late for acknowledgment.

G. A. Forde.—Some of our solvers object to sui-mates. Nevertheless their indignation shall occasionally be braved if a good specimen, in two or three moves, is sent in.

Henry Bristow.—We gladly notice your booklet next month.

W. H. Jones.—If 1. R. to Q3, the Black King escapes.

N. M. Munro.—Your problem is not sound; there appears to be only one "threat" and there are several defences to it. Can you revise it? Your other question has been answered in the daily press.

A. P. M.—The solution of No. 1 (June) is quite correct. In the variations you mention the White King retakes the Pawn or Rook, discovering check-mate from the White Rook.

I. M. Brown (Bradford).—Change of address noted.

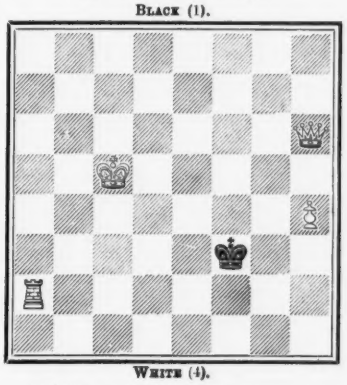
E. Servante.—I should recommend you to write to Dr. Hunt, 101, Queen's Road, Dalston, N.

PROBLEMS.

No. 1.

By Rev. E. Cowley.

BLACK (1).



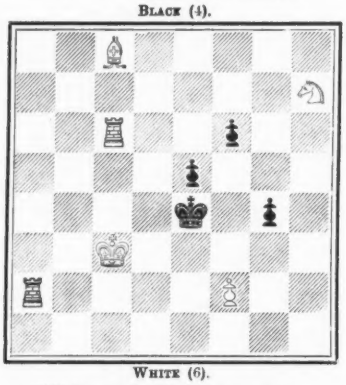
WHITE (4).

White mates in three moves.

No. 2.

By W. Clugston (Belfast).

BLACK (4).



WHITE (6).

White mates in two moves.

[Will correspondents kindly notice the alteration of address mentioned at the beginning of this column.]

CHESS INTELLIGENCE.

The London International Tournament was brought to a conclusion on July 10th, with the following result:—

	1st Round.	2nd Round.	Total.
Lasker ...	11 ...	11½ ...	22½
Janowski ...	9½ ...	8½ ...	18
Pillsbury ...	9½ ...	8½ ...	18
Maroczy ...	10 ...	8 ...	18
Schlechter ...	9½ ...	7½ ...	17
Blackburne ...	8½ ...	7 ...	15½
Tchigorin ...	8 ...	7 ...	15
Showalter ...	6½ ...	6 ...	12½
Mason ...	5 ...	7 ...	12
Cohn ...	8 ...	3½ ...	11½
Steinitz ...	6½ ...	5 ...	11½
Lee	4 ...	5½ ...	9½
Bird	4 ...	3 ...	7
Tinsley ...	3 ...	2 ...	5

The prize list is as follows:—

E. Lasker, first	...	£250
M. Janowski, H. N. Pillsbury, G. Maroczy	second, third, and fourth ...	115
C. Schlechter, fifth ...	...	65
J. H. Blackburne, sixth ...	...	50
M. Tchigorin, seventh ..	...	40
J. W. Showalter, eighth ...	...	30
J. Mason, ninth	...	20

Mr. Teichmann was also a competitor, but retired owing to ill-health after playing four games, his score then being two.

A comparison of the prize list with the July number of KNOWLEDGE will show that our prediction as to the ultimate first four did not err on the side of rashness. Mr. Lasker's performance was a remarkably fine one. He lost one game only out of twenty-seven, seven being drawn, and has more than justified his claim to be considered the finest living player. M. Janowski was leading for some time, but fell off slightly; no competitor drew fewer games. Herr Maroczy, on the contrary, drew ten games, and lost only four to M. Janowski's seven. Mr. Pillsbury invariably played to win, and ran many risks throughout. Nevertheless he won two games less than M. Janowski, and drew twice as many. Herr Schlechter drew eight games, a very small number for him. Mr. Blackburne, after a rather poor start, played up excellently; he was the only player who defeated Mr. Lasker. M. Tchigorin also improved after the first week or two, as also did Mr. Mason, but Mr. Showalter fell off after a good start. Herr Cohn also started capitally, but fell all to pieces in the second round. Of Mr. Steinitz we do not know what to say, except that he has never in his long career failed so unaccountably. Mr. Lee did fairly well to win six games and draw seven in such company. The other two Englishmen made poor scores.

Two of the best-known English chess-players joined the majority last month. One, the Rev. G. A. Macdonnell, was one of the finest amateurs in the days of Staunton, Boden and Buckle. He was for many years Chess Editor of the *Sporting and Dramatic News*, and was the author of "Chess Life Pictures," and "The Knights and Kings of Chess." Mr. Macdonnell had been in failing health some time before his death at the age of 69. The other, Mr. Edmund Thorold, of Bath, is best known as the inventor of the variation of the Allgaier Gambit, which has superseded all others, and which will bear his name as long as chess lasts. He was a most brilliant player, and took part in many of the meetings of the Counties Chess Association, and in the International Tournaments at Bradford and Manchester in 1888 and 1889. Mr. Thorold's name will be always associated with three others—Skipworth, Ranken and Wayte. Of these four Mr. Ranken is now alone left.

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